Annals
of the
Missouri Botanical Garden

VOL. I NOVEMBER, 1914 No. 4

THE THELEPHORACEÆ OF NORTH AMERICA III[1]

CRATERELLUS BOREALIS AND CYPHELLA

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Since the publication of Part II, on *Craterellus*, Dr. Farlow has very kindly called my attention to, and permitted me to study, a specimen of a rare species from Labrador which was not included in my account of our North American species. This species is now described here so as to bring its description and illustration continuous with those of our other species of *Craterellus*.

The following is suggested for insertion in "Key to the Species," on page 328 (Ann. Mo. Bot. Gard. 1: 328. 1914).

6. Pileus membranaceous, infundibuliform, pale buff; hymenium pale buff; spores 5–7 x 4–5½ μ; from Labrador. See page 357 (Ann. Mo. Bot. Gard. 1: 357. 1914)..... *C. borealis.*

Craterellus borealis Burt, n. sp. Plate 19. fig. 1.

Type: in Farlow Herb.

Fructifications solitary, small; pileus infundibuliform, tapering uniformly to the stem, glabrous, drying between cartridge buff and cream-buff, the margin entire; stem nearly equal,

NOTE.—Explanation in regard to the citation of specimens studied is given in Part I, Ann. Mo. Bot. Gard. 1: 202. 1914, footnote. The technical color terms used in this work are those of Ridgway, Color Standards and Nomenclature. Washington, D. C., 1912.

[1] Issued January 30, 1915.

slender, minutely downy, pale mouse-gray; hymenium colored like the pileus, remotely ribbed, with the ribs radiating from the stem, thin, branching; spores colorless, even, 5–7 x 4–5½ μ.

Fructification 2 cm. high; pileus 1 cm. broad, 13 mm. long; stem 7 mm. long, ½ mm. thick, enlarging to 1 mm. where joining the pileus.

In moss. Labrador. August 8, 1908.

The above description is based on the single dried specimen collected by the Bryant Labrador Expedition. The small size, regular obconic form, and very pale color of the membranaceous pileus and the slender stem are characters making *C. borealis* clearly distinct from other species of *Craterellus*.

Specimens examined:

Labrador: Gready Harbor, Gready Island, *Owen Bryant*, type (in Farlow Herb.).

CYPHELLA

Cyphella Fries, Syst. Myc. 2: 201. 1823.

Fructifications somewhat membranaceous, cup-shaped, rarely plane, adnate behind, commonly extended in stem-like form, pendulous; hymenium typically concave or disk-shaped, definitely inferior in the pendulous species, even or at length rugulose; basidia typically four-spored; spores subovate or globose, hyaline, rarely colored.

C. digitalis Fries is the type species of this genus.

The fructifications of all our North American species are comparatively small, ranging in diameter from a fraction of a millimeter for some species to five to fifteen millimeters for those of the largest species. The fructifications are produced on the bark of small rotting twigs on the ground and on dead herbage, and can only be distinguished from small *Peziza* by demonstrating basidia rather than asci in the hymenium. This demonstration is simply made by crushing under a cover glass a portion of a fructification in water containing a little seven per cent solution of potassium hydrate, and then examining the preparation with the compound microscope. The basidia are usually four-spored; in a few species I have as yet been able to detect only two-spored basidia.

Cyphella is closely related to *Solenia* by such species as *C. fasciculata* and *C. mellea*, but is separated from it in such cases

by the absence of a hyphal subiculum over the area on which the fructifications are distributed, and by the less cylindric form of fructifications of *Cyphella*. *Cyphella* is allied to *Merulius* by *C. muscigena* and also to *Craterellus* by this species, specimens of which were described as a *Craterellus*.

A few species of *Cyphella* are common and widely distributed, but most of our North American species are apparently extremely local and are known only from their respective type collections. The lack of specimens available for carrying about to compare with types has been a serious disadvantage in my study of this genus. Basidia and basidiospores have not as yet been found for some species which, although originally referred to *Cyphella*, have to be regarded as even doubtful *Basidiomycetes*. I have supplemented the original descriptions with measurements of dried fructifications and with such data in regard to basidia and spores as the specimens afford. In the case of very scanty types, the few fructifications are too precious for gross comparison to be used for microscopic study. For such species, it seems to me that the descriptions should stand on the original data, without prejudice, until new collections become available. Such imperfectly known and partially described species are grouped together under the heading "Species Imperfectly Known." *Cyphella convoluta* Cke., *C. Cupressi* (Schw.) Fries and *C. subcyanea* Ell. & Ev. are excluded species.

Key to the Species

Fructifications sulphur-colored; hymenium even; spores 4½x2½–3 μ ..... *1. C. sulphurea*
Fructifications sulphur-colored; hymenium minutely pitted; spores 6–8 x 3–4 μ ..... *2. C. lata*
Fructifications white or whitish; on mosses 1
Fructifications white; not on mosses 2
Fructifications neither white nor sulphur-colored 3
1. Fructifications helmet-shaped; hymenium slightly wrinkled; spores 10 x 8 μ ..... *3. C. galeata*
1. Fructifications flattened, irregular in form, sometimes stipitate; spores 3–5 x 2–3 μ ..... *4. C. muscigena*
1. Fructifications seated upon or developing from webby strings of mycelium ..... *5. C. arachnoidea*
2. Fructifications villose, not easily crushed, with a firm base or a short stem; spores 12–18 x 6–6½ μ ..... *6. C. Tiliæ*
2. Fructifications villose, easily crushed, sessile; spores 10–12 x 5–7 μ ..... *7. C. villosa*
2. Fructifications whitish, minutely webby-hairy, easily crushed, sessile; spores 8–13 x 4 μ ..... *8. C. caricina*

2. Fructifications glabrous, with an oblique stem; spores 4½–6 x 3–3½ μ *9. C. capula*
2. Fructifications villose, snow-white, sessile, very minute and delicate; spores 5–6 x 4–4½ μ; from New England *10. C. minutissima*
2. Compare with *C. cinereo-fusca, C. Palmarum, C. Peckii, C. perexigua, C. pezizoides* and *C. trachychæta* of "Species Imperfectly Known."
3. Fructifications wholly pale ivory-yellow, downy-pubescent, cup-shaped, sessile; spores 4–7 x 3–4 μ *11. C. Langloisii*
3. Fructifications wholly cream-color, not hairy, helmet-shaped, sessile, resupinate-reflexed; hymenium wrinkled; spores 7½ x 4½ μ; on prickle-bearing stems, Jamaica *12. C. porrigens*
3. Fructifications mineral-gray, tomentose, cup-shaped, sessile; hymenium fuscous; spores angular, 4½–6 x 4½ μ; on *Juniperus* *13. C. cupulæformis*
3. Fructifications wholly gray-pallid, flocculose, sessile; spores 4 x 3 μ *14. C. griseo-pallida*
3. Fructifications externally cinereous, farinaceous, flattened, sessile; hymenium convex, brown; spores 8 x 3½ μ; on *Alnus* *15. C. subgelatinosa*
3. Fructifications darker colored than the above 4
4. Fructifications vinaceous-buff, hairy, sessile, ½ mm. broad; spores 10–12 x 6–8 μ; on bark of *Carya* *16. C. Ravenelii*
4. Fructifications drying Isabella-color, hairy, sessile, 1–1½ mm. broad; spores 13 x 8 μ; on *Quercus* *17. C. texensis*
4. Fructifications Isabella-color, hairy, sessile, ½–½ mm. broad; some spores colored, 5–6 x 4–4½ μ; on *Salix* *18. C. mellea*
4. Fructifications tawny-olive, tomentose, stipitate; often cespitose; spores 7–9 x 2–2½ μ; usually on *Alnus* *19. C. fasciculata*
4. Fructifications fuscous when moist, drying mouse-gray, cespitose and sessile on a common short trunk, glabrous, structure gelatinous *20. C. conglobata*
4. Fructifications sepia or olive-brown, cup-shaped, probably glabrous, sessile or with a very short stem; spores 6–8 x 3½–4 μ; on rotting leaves of *Gladiolus* *21. C. fumosa*
4. Compare *C. Bananæ, C. filicicola* and *C. musæcola* in "Species Imperfectly Known."

1. C. sulphurea Batsch ex Fries, Hym. Eur. 665. 1874.

Peziza sulphurea Batsch, Elenchus Fung. Contin. 1: 209. *pl. 27. f. 146.* 1786.—*P. campanula* Nees, System d. Pilze 268. *f. 295.* 1816.—*Cyphella sulphurea* Batsch, in Patouillard, Tab. Anal. Fung. 114. *f. 256.* 1883; Peck, Rep. N. Y. State Mus. 31: 38. 1879.

Illustrations: Batsch, Elenchus Fung. Contin. *pl. 27. f. 146.*—Nees, System d. Pilze *f. 295.*—Patouillard, Tab. Anal. Fung. *f. 256.*—Oudemans, Ned. Kruidk. Archief III. 2: *pl. 3. f. 1–5.*

Fructifications scattered or gregarious, membranaceous, broadly campanulate, somewhat irregular, extended into a short stem, even, glabrous, sulphur-yellow, the margin somewhat repand; hymenium even; basidia cylindric, 16 x 4½ μ, 4-spored;

spores colorless, even, broadly ovoid, somewhat flattened on one side, 4½ x 2½–3 μ.

Fructifications about 2–3 mm. high; pileus 1–2 mm. broad; stem 1 mm. long, ¼ mm. thick.

On living stems of herbs in damp places. New York. September. Rare.

The minimum dimensions given above for the fructifications are about those of European specimens of this species as figured; the American specimens run rather larger in Peck's collection. Peck noted that some of his specimens were white when collected, but that they dried yellow like the others of the collection. In other respects our American specimens agree closely with the figures and description of European specimens. Oudemans gives the spore dimensions as 10–12 x 4–5 μ, but Patouillard gives them as they are in American specimens.

Specimens examined:

New York: Griffins, Delaware Co., *C. H. Peck* (in Coll. N. Y. State).

2. **C. læta** Fries, Epicr. 568. 1836–1838.

Illustrations: Patouillard, Tab. Anal. Fung. *f. 362.*

Fructifications membranaceous, obliquely cup-shaped, extended at the vertex into a stem, pendulous, entire, everywhere glabrous and sulphur-colored; stem straight or somewhat flexuous, hymenium minutely pitted; spores colorless, even, 6–8 x 3–4 μ, borne four to a basidium.

Fructifications 3–5 mm. high, 2–4 mm. broad; stem 1–2 mm. long, about ½ mm. thick.

On dead stems of large herbs lying on the ground. New York. August.

Fries described the fructifications as 6–8 mm. broad; the dimensions given above are those of Patouillard's figures and of the specimens collected by Peck. Patouillard notes that the specimens blacken when old; Peck states, "The beautiful sulphur-color is lost in drying." The pitted surface of the hymenium is a noteworthy character of *C. læta* and this and the larger spores of *C. læta* distinguish it from *C. sulphurea.*

Specimens examined:

New York: East Berne, *C. H. Peck* (in Coll. N. Y. State).

3. **C. galeata** Schum. ex Fries, Epicr. 567. 1836–1838.

Plate 19. fig. 2.

Merulius galeatus Schum. Plant. Sællandiæ **2**: 371. 1803.—*Cantharellus galeatus* Fries, Syst. Myc. **1**: 524. 1821; Flor. Dan. **12**: fasc. 34. 11. *pl. 2027. f. 1.* 1830.

Illustrations: Flor. Dan. *pl. 2027. f. 1.*

Fructifications membranaceous-soft, somewhat sessile, obversely cup-shaped and then dimidiate, helmet-shaped, even, whitish, the margin entire; hymenium at length rufescent, slightly wrinkled; spores ovate or obovate, 10 x 8 μ.

Fructifications 4–15 mm. in diameter.

On mosses. Ohio.

When young entire, cup-shaped; gray when moist, snow-white when dry, then rufescent. The above description is that given in European works. The species has been reported from Ohio by Morgan but I have not studied his specimens nor any European specimens of this species. The form and coloration of the pileus and the large spores should distinguish *C. galeata* from the other species which occur on mosses in North America.

4. **C. muscigena** Pers. ex Fries, Epicr. 567. 1836–1838.

Plate 19. fig. 3.

Thelephora muscigena Pers. Syn. Fung. 572. 1801; Fries, Syst. Myc. **1**: 524. 1821.—*T. vulgaris α candida* Pers. Myc. Eur. **1**: 115. *pl. 7. f. 6.* 1822.—*Cantharellus lævis* Fries, Syst. Myc. **1**: 524. 1821; Elenchus Fung. 55. 1828.—*Craterellus Pogonati* Peck, Bull. Torr. Bot. Club **33**: 218. 1906.

Illustrations: Persoon, Myc. Eur. **1**: *pl. 7. f. 6.*—Patouillard, Tab. Anal. Fung. *f. 465.*—Oudemans, Ned. Kruidk. Archief III. **2**: *pl. 11. f. 2.*

Pileus membranaceous-soft, sessile, stipitate or attached by upper surface, irregular, flattened, white, externally minutely tomentulose or silky under a lens; stem when present lateral or eccentric, slender, white; hymenium even or sometimes rugulose, drying pinkish buff; spores white in collection on slide, even, apiculate at base, flattened on one side, 4½–5 x 2½–3 μ but only 3–4½ x 2–3 μ in preparations of the hymenium, borne four to a basidium.

Pileus 2–6 mm. in diameter; stem when present 3–5 mm. long, ½ mm. thick.

On *Polytrichum* and other mosses. New England and New York. August and September.

The fructifications are very variable in form and they are attached in various ways to the moss plants; they may be somewhat incrusting but at some distance above the ground. The substance of the pileus is very soft and its upper surface is somewhat bibulous and shows its interwoven fibers under a lens. The spores of this species are given in Saccardo's 'Sylloge' as 8–10 x 5 μ, but the European specimens of exsiccati cited below have small spores of the dimensions which I give for American specimens, and Bresadola, Ann. Myc. 1: 111. 1903, gives the spore dimensions as 3–4 x 3 μ. The specimens of *C. Pogonati* were described as sterile by Peck; I find them to be rather immature but bearing spores 3 x 2 μ.

Specimens examined:

Exsiccati: Karsten, Fung. Fenn., 441; Krieger, Fung. Sax., 1564.
Finland: *Karsten* (in Herb. Fries), and Fung. Fenn., 441.
Germany: Saxony, *W. Krieger*, Krieger, Fung. Sax., 1564.
Vermont: near Falls of Lana, Salisbury, *E. A. Burt.*
Connecticut: South Windsor, *C. C. Hanmer, 1956*, the type collection of *Craterellus Pogonati* Pk.
New York: Floodwood, *E. A. Burt.*

5. C. arachnoidea Peck, Rep. N. Y. State Mus. 44: 134 (22). 1891.

Type: in Collection New York State.

Fructifications membranaceous, very thin, tender, white, externally downy, irregularly cup-shaped; hymenium somewhat uneven in large specimens; spores colorless, even, somewhat flattened on one side, 4–5 x 3½–4 μ, borne at least two to a basidium.

Fructifications 2–4 mm. in diameter.

On bark and mosses. Vermont and New York. September.

The cups are seated upon or developing from fine, white, loosely branching, webby strings of mycelium. This is a marked character in the type and is the chief character for separating this species from *C. muscigena.* The spores are slightly more globose than in the latter and it may be that the hymenium of *C. arachnoidea* is superior; in *C. muscigena* it is inferior. The hyphæ are about 2 μ in diameter in each species.

Specimens examined:

Vermont: South Lincoln Notch, near Middlebury, *E. A. Burt.*

New York: Carrollton, *C. H. Peck*, type (in Coll. N. Y. State).

6. C. Tiliæ Peck ex Cooke, Grevillea **20**: 9. 1891.

Plate 19. fig. 16.

Peziza Tiliæ Peck, Rep. N. Y. State Mus. **24**: 96. 1872.—*Trichopeziza Tiliæ* (Peck) Sacc. Syll. Fung. **8**: 428. 1889; Seaver, Proc. Iowa Acad. Sci. **12**: 116. 1905; Mycologia **1**: 110. 1909.

Type: in Collection New York State and a portion from it in Kew Herbarium.

Fructifications gregarious, rather fleshy, minute, sessile or nearly so but with firm base, white, globose, then expanded and concave, drying cup-shaped, densely white villose; hairs straight, cylindric, granular incrusted, 200 x 6 μ; hymenium concave, even, ivory-yellow to vinaceous buff; spores white in a collection on a slide, simple, even, ovate, somewhat curved, 12–18 x 6–6½ μ, borne four to a basidium.

Fructifications ½–1 mm. high, ⅓–1 mm. broad; stem, when present, about one-half the height of the whole fructification.

On bark of dead branches of *Tilia Americana* and *Ulmus* on the ground. Canada and Vermont westward to Missouri. March to October. Probably common.

C. Tiliæ has somewhat the habit of *C. albo-violascens* but differs from the latter in having no violaceous tints, in being more hairy, in having slenderer spores, and in having at the base a very firm tubercle which offers considerable resistance when the fructification is crushed under a cover glass or sectioned. While not cespitose the fructifications of *C. Tiliæ* are often so near together that seven or eight have been counted on an area a centimeter square. I refer to *C. Tiliæ* many American specimens which have been distributed under the name *C. pezizoides* Zopf. The European specimens which Sydow has distributed under the latter name seem to me from the studies and comparisons which I made in Kew Herbarium to be *C. Curreyi* B. & Br. rather than *C. Tiliæ*.

Specimens examined:

Exsiccati: Shear, N. Y. Fungi, 55; Ell. & Ev., N. Am. Fungi, 2316a, under the name *C. pezizoides;* Ell. & Ev., Fung.

Col., 5, under the name *C. pezizoides;* Rabenhorst, Fung. Eur., 3942, under the name *C. pezizoides.*

Quebec: Hull, *J. Macoun, 672.*

Ontario: Ottawa, *J. Macoun, 318, 430;* London, *J. Dearness,* Ell. & Ev., N. Am. Fungi, 2316a, and Fung. Col., 5.

Vermont: Middlebury, *C. O. Smith,* and also *E. A. Burt.*

New York: Knowersville (Altamont), *C. H. Peck,* type (portion in Kew Herb.); Alcove, *C. L. Shear,* Shear, N. Y. Fungi, 55.

Ohio: Oberlin, *F. D. Kelsey* (in Mo. Bot. Gard. Herb., 4942).

Michigan: Agricultural College, *G. H. Hicks,* comm. by W. G. Farlow, 6 (in Mo. Bot. Gard. Herb., 43807).

Wisconsin: Blue Mounds, *I. E. Melhus,* comm. by C. J. Humphrey, 2410 (in Mo. Bot. Gard. Herb.).

Missouri: *C. H. Demetrio,* Rabenhorst, Fung. Eur., 3942.

7. C. villosa Pers. ex Karsten, (Mycol. Fenn. 3) Bidrag Finska Vet.-Soc. **25**: 325. 1876. Plate 19. fig. 13.

Peziza villosa Pers. Syn. Fung. 655. 1801; Fries, Syst. Myc. **2**: 104, pr. p. 1823.—An *Cyphella pezizoides* Zopf, in Morgan, (Myc. Fl. Miami Val.) Jour. Cincinnati Soc. Nat. Hist. **10**: 202. 1888?

Illustrations: Patouillard, Tab. Anal. Fung. *f. 257.*

Fructifications gregarious, membranaceous, sessile, drying globose or obconic and with the pore nearly closed by the hairs, white, externally white-villose; the hairs granular incrusted, cylindric, 200 x 5–6 μ; hymenium even, concave; spores hyaline, even, ovoid, flattened on one side, broadest near the base, 10–12 x 5–7 μ.

Fructifications about $\frac{1}{2}$ mm. high, $\frac{1}{3}$–$\frac{1}{4}$ mm. broad.

On dead stems of *Artemisia, Helianthus,* and *Solidago.* South Carolina, Missouri and California. June and July.

The fructifications of *C. villosa* resemble those of *C. Tiliæ* in form, color, and hairiness but are much smaller than those of *C. Tiliæ,* more membranaceous and easily crushed under a cover glass, and have smaller spores. The hymenium is very pale with not more than a very slight yellowish tint.

Specimens examined:

Exsiccati: Krieger, Fung. Sax., 1457; Ravenel, Fung. Am., 459; Ell. & Ev., N. Am. Fungi, 2316b, under the name *Cyphella pezizoides* Zopf.

South Carolina: Aiken, *Ravenel*, Ravenel, Fung. Am., 459.
Missouri: Emma, *C. H. Demetrio*, Ell. & Ev., N. Am. Fungi, 2316b.
California: Half-moon Bay, San Mateo Co., *E. B. Copeland*, Baker, Pacific Coast Fungi, 3611 (in Mo. Bot. Gard. Herb., 4944).

8. C. caricina Peck, Rep. N. Y. State Mus. **33**: 22. 1880.
Plate 19. fig. 8.

Type: in Collection New York State.

Fructifications scattered, membranaceous, sessile, wholly white, externally minutely webby-hairy; hymenium glabrous, uneven in large specimens; basidia cylindric, 20 x 5 μ, 4-spored; spores colorless, even, lanceolate or subclavate, pointed at base, 8–13 x 4 μ.

Fructifications 1–2 mm. broad.

On culms and leaves of carices. New York. August.

The spores of the type are noteworthy by their tapering base.

Specimens examined:

New York: Verona, *C. H. Peck*, type (in Coll. N. Y. State).

9. C. capula Holmsk. ex Fries, Epicr. 568. 1836–1838.
Plate 19. fig. 4.

Peziza Capula Holmsk. Nov. Act. Havn. **1**: 286. *f. 7;* Fung. Dan. **2**: 41. *pl. 22.* 1899.

Illustrations: Holmskiold, Nov. Act. Havn. **1**: 286. *f. 7;* Fung. Dan. **2**: *pl. 22.*—Flor. Dan. **33**: *pl. 1970. f. 3.*—Patouillard, Tab. Anal. Fung. **1**: *f. 35.*

Fructifications membranaceous, obliquely campanulate, extended into an oblique stem, glabrous, whitish, the margin sinuate, irregularly shaped; hymenium even. . . . On dead stems of herbaceous plants.

—Translation of description in Fries' 'Epicrisis.'

Fructifications in the figures of Holmskiold 4–9 mm. high; pileus 2–7 mm. long, 2–4 mm. broad; stem 1–2 mm. long.

On dead stems of *Fœniculum* and other herbs. New York and South Carolina.

I have not been able to study any European specimens of this species. In the copy of Cooke's 'Fungi Britannici' in the herbarium of the Missouri Botanical Garden the packet labeled *C. capula*, 112, contains only some pieces of stubble. The Amer-

ican specimens distributed in Ravenel's 'Fungi Americani,' 458, were determined by Cooke. In their present dried condition these specimens agree well with Holmskiold's illustrations in form; the stem of these specimens is now hair-brown and the pileus pale olive-buff; their dimensions are: fructifications 1–3 mm. long, pileus ½–2 mm. long and broad; stem ½–1 mm. long x 100 μ thick. The basidia are 16–20 x 3½–4½ μ; spores colorless, even, flattened on one side, 4½–6 x 3–3½ μ.

Specimens examined:

Exsiccati: Ravenel, Fung. Am., 458.

South Carolina: Aiken, *Ravenel*, Ravenel, Fung. Am., 458.

10. C. minutissima Burt, n. sp. Plate 19. fig. 5.

Type: in Mo. Bot. Gard. Herb. and in Farlow Herb.

Fructifications gregarious, very minute, membranaceous and very delicate, sessile, globose, snow-white, externally villose, often with mouth oblique, margin inrolled; hairs white, incrusted, 75–90 x 4 μ; hymenium concave, white; basidia clavate, 16 x 4 μ; spores colorless, even, 5–6 x 4–4½ μ.

Fructifications 200–500 μ broad, about 200–500 μ high.

On inner bark of *Populus*. New Hampshire. August.

The characters of this species agree in some details with those in the incomplete description of *C. globosa* Pat., the specimens of which were collected on the under side of leaves of ferns in Ecuador by von Lagerheim, but as no mention is made of spore characters for *C. globosa* and as other species of *Cyphella* have not been found to vary widely with regard to kind of substratum, it seems best to regard our New England species as probably distinct. *C. punctiformis* (Fries) Karst. is a small white *Cyphella*, described by Karsten as having spores 5–8 x 2–4 μ; I have not been able to study authentic specimens of *C. punctiformis*, but comparison of *C. minutissima* with this species of northern Europe should be made.

I refer to *C. minutissima* a collection made by myself in Vermont on bark of rotting locust limbs. The fructifications of this collection lack spores but agree in all other respects with the type.

Specimens examined:

New Hampshire: Chocorua, *W. G. Farlow, 3*, type (in Mo. Bot. Gard. Herb., 43803, and in Farlow Herb.).

Vermont: Middlebury, *E. A. Burt.*

11. C. Langloisii Burt, n. sp. Plate 19. fig. 6.

Type: in Farlow Herb. and Burt Herb.

Fructifications gregarious, membranaceous, cup-shaped, sessile, drying pale ivory-yellow, externally downy pubescent, the margin inrolled; hairs colorless, somewhat crinkled together, granular incrusted, 100–150 x 3½–4½ μ; hymenium concave, even, pale ivory-yellow to cream color; spores colorless, even, pointed at the base, 4–7 x 3–4 μ; basidia clavate, 20 x 5μ, 2-spored.

Fructifications about ¼ mm. high; ¼–½ mm. broad.

On dead stems of *Arundinaria* and on decaying pieces of wood lying on the ground. Louisiana. September and April.

The fructifications of *C. Langloisii* are about as small as those of *C. minutissima* but differ from them in being somewhat extended laterally and occasionally somewhat laterally confluent rather than always globose, in having an ivory-yellow rather than snow-white color, and in having the hymenium colored and the hairs longer than in *C. minutissima*. Comparison should be made with *C. fraxinicola* B. & Br., of which I have studied no specimens but which seems distinct by some characters of the incomplete published description.

Specimens examined:

Louisiana: St. Martinville, *A. B. Langlois, 1802*, type (in Farlow Herb.), and *cz*, type, in Burt Herb., and *cy*, and from the same collector but comm. by W. G. Farlow, 5 (in Mo. Bot. Gard. Herb., 43791).

12. C. porrigens Burt, n. sp. Plate 19. fig. 7.

Type: in Burt Herb. and New York Bot. Gard. Herb.

Fructifications scattered, membranaceous, thin, wholly cream-color, sessile, obversely cup-shaped or helmet-shaped, resupinate by the upper surface of one side but with the greater portion of the pileus extended and reflexed; hymenium inferior, somewhat wrinkled when moistened, concave, basidia clavate, 20–25 x 4–4½ μ, with four sterigmata; spores colorless, even, flattened on one side, obovate, 7½ x 4½ μ.

Fructifications ½–1 mm. broad.

On dead prickle-bearing stems, possibly *Rubus sp.* Wet mountainous region at altitude 4500–5200 feet. Cinchona, Jamaica. About January 1.

This species does not appear closely related to any other

species; it is marked by the resupinate-reflexed habit of most fructifications; only rarely is a fructification attached by its vertex. The dried specimens are externally minutely fibrillose under a lens but do not show hairs in microscopic preparations. When the fructifications are moistened the hymenium shows two or three minute wrinkles radiating from an eccentric point.

Specimens examined:

Jamaica: Cinchona, *W. A. and Edna L. Murrill,* N. Y. Bot. Gard., Fungi of Jamaica, 607, type.

13. C. cupulæformis Berk. & Rav. Grevillea **2**: 5. 1873. Plate 19. fig. 9.

Type: type and cotype in Kew Herb. and in Curtis Herb. respectively.

Fructifications scattered, rarely in clusters of two or three, sessile, cup-shaped, somewhat globose, externally mineral gray and obscurely tomentose, the margin incurved; hymenium concave, even, fuscous; basidia clavate, 20–25 x 4–6 μ, having 2–4 sterigmata which become finely attenuated; spores colorless, angular, 4½–6 x 4½ μ.

Fructifications ½ mm. high, ½–1 mm. broad.

On bark of *Juniperus virginiana.* South Carolina and Georgia.

The hairiness of the exterior of the pileus is due to the irregularly curved and interwoven hyphæ which form the surface layer of the pileus; these hyphæ are colorless and about 3 μ in diameter, and they bear scattered but large incrusting granules. The angular spores of this species are often octahedral in form and are noteworthy for *Cyphella;* at maturity, they are attached to the basidium by sterigmata becoming 6 μ long and so finely attenuated that the attachment of the spores to the basidia is made out with difficulty. This species may be readily known by its occurrence on bark of *Juniperus virginiana* and by its angular spores.

Specimens examined:

Exsiccati: Ravenel, Fung. Am., 224.

South Carolina: *Ravenel, 1403,* type (in Kew. Herb.).

Georgia: Darien, *Ravenel,* Ravenel, Fung. Am., 224.

14. C. griseo-pallida Weinm. Hymeno- et Gastero-mycetes in Rossico. 522. 1836.

Illustrations: Patouillard, Tab. Anal. Fung. *f. 255.*

Fructifications gregarious, adnate-sessile, membranaceous, wholly gray-pallid, externally flocculose; hymenium glabrous, even.

At first having the form of globose, closed granules, soon open, campanulate or crateriform, often dimidiate in old stages.

Fructifications ½ mm. high, ½–2 mm. broad.

On moist ground and on pine wood thinly covered with earth and on old cracked trunks of *Lonicera tartarica* (in Europe).

—Translation of original description.

On bark, twigs and leaves lying on the ground. New York and Ohio. November.

I have not seen the type of *C. griseo-pallida* nor any European specimens which have been compared with it, but Peck, Rep. N. Y. State Mus. **30**: 48. 1879, has referred to this species a collection which he made at Sand Lake, New York. Peck notes that his specimens sometimes have a very short stem. I found the spores of these specimens hyaline, even, somewhat flattened on one side, 4 x 3 μ; basidia 12 x 4 μ.

Specimens examined:

New York: Sand Lake, *C. H. Peck* (in Coll. N. Y. State).

15. C. subgelatinosa Berk. & Rav. Grevillea **2**: 5. 1873.

Type: in Kew Herb.

Fructifications scattered, somewhat gelatinous, sessile, flattened, externally cinereous and farinaceous, the thin margin inflexed; hymenium slightly convex, even, brown; basidia clavate, about 25 x 5–6 μ, probably 2-spored; spores colorless, even, ellipsoidal, 8 x 3½ μ.

Fructifications about 1½ mm. broad.

On *Alnus serrulata*. South Carolina.

The fructifications of the type have dried with the slightly convex hymenium so prominently visible that they resemble brown apothecia of lichens with a pale margin (exciple). The most of the basidia are immature; I found one showing two sterigmata distinctly. No spores were found attached to basidia; the spore characters, which are given above, are those of loose spores in the preparation. *C. subgelatinosa* is so very distinct from our other species of *Cyphella* that it will probably be overlooked by botanists collecting *Basidiomycetes* only, unless especially kept in mind.

Specimens examined:

South Carolina: Aiken, *Ravenel, 1714*, type (in Kew Herb.).

16. C. Ravenelii Berk. Grevillea **2**: 5. 1873. Plate 19. fig. 14.

Type: type and cotype in Kew Herb. and in Curtis Herb. respectively.

Fructifications single or gregarious, sessile, subglobose, somewhat flattened, depressed at the pore, minutely hairy under a lens, vinaceous buff; hairs minutely rough, about 300 μ long, 4 μ thick, tapering towards the free end, olive-yellow under the microscope; spores hyaline, or perhaps very slightly colored, even, broadly ellipsoidal, 10–12 x 6–8 μ.

Fructifications 0.6 mm. high, 0.8 mm. broad; pore 0.15 mm. in diameter.

On bark of *Carya*. South Carolina.

The specimens of this species which I have seen have been on thick and cracked portions of bark apparently from large branches or the main trunk of the tree. Sometimes only one fructification occurs on a piece of bark a centimeter square; sometimes such a piece bears from 3 to 6 fructifications with some of them barely in contact with one another. The type specimen contains so few fructifications that I made a microscopic preparation at Kew Herbarium from the specimen distributed by Ravenel in Ellis, N. Am. Fungi, 721, which seems to me to be certainly the same species as the type. Berkeley described the spores in his original description as "elliptic, .00025 (in.) long"; I found them about twice this length in my preparation referred to and also in a preparation recently made from the specimen in Ravenel, Fung. Am., 130, in the Mo. Bot. Gard. Herb.

Specimens examined:

Exsiccati: Ravenel, Fung. Am., 130; Ellis, N. Am. Fungi, 721.

South Carolina: Aiken, *Ravenel, 1755*, the type and cotype (in Kew Herb. and in Curtis Herb. respectively); and also Aiken, *Ravenel*, Ravenel, Fung. Am., 130, and Ellis, N. Am. Fungi, 721.

17. C. texensis Berk. & Curtis, Grevillea **20**: 9. 1891. Plate 19. fig. 10.

Type: in Kew Herb.

Fructifications scattered, sessile, pallid but at present time

Isabella-color (melleus of 'Chromotaxia'), cup-shaped, at length flattened and disk-shaped, externally hairy; hairs olive-ocher under the microscope, granular incrusted, cylindric, 300–400 x 4½–6 μ; basidia clavate, 25–30 x 6–8 μ, 4-spored; spores hyaline, even, broadly ellipsoidal, 13 x 8 μ.

Fructifications 1–1½ mm. broad.

On *Quercus*. Texas.

The type is scanty, consisting of three fructifications, but these fructifications are in fine condition and present well the characters of the species. *C. texensis* now impresses me as more closely related to *C. Ravenelii* than I observed when studying the specimens of both in Kew Herbarium. The fructifications of *C. texensis* are the melleus of Saccardo's 'Chromotaxia' and the hairs are of a little greater diameter and have larger incrusting granules than those of *C. Ravenelii*, but the spores and basidia are very similar in form and dimensions in both species.

Specimens examined:

Texas: *Wright, 3779*, type (in Kew Herb.).

18. C. mellea Burt, n. sp. Plate 19. fig. 12.

Type: in Burt Herb. and in U. S. Dept. Ag. Herb.

Fructifications closely gregarious, sessile, Isabella-color, spherical and with margin inrolled in the dried state, sometimes obconic, externally hairy; hairs granular incrusted, baryta-yellow under the microscope, cylindric, 80–100 x 3½–4 μ; hymenium even, whitish or pale olive-buff; basidia clavate, 12–16 x 6 μ; spores mostly colorless but some pale baryta-yellow, even, broadly ellipsoidal, 5–6 x 4–4½ μ.

Fructifications about ⅛–½ mm. high and broad.

On rotten wood of *Salix nigra*. Louisiana. December.

In the specimen upon which the description is based, the most of the fructifications are about ⅛ mm. high and broad and are distributed on the rotten wood at the rate of about 200 per square centimeter. Rarely a short stem-like base is visible when the fructifications emerge from the bottom of small crevices between the fibers of the wood, but the fructifications are generally sessile. The species is intermediate between *Cyphella* and *Solenia* but is included in the former genus because the fructifications do not arise from a common subiculum and are more globose than in *Solenia*. The description of *C. mellea* suggests

those of *C. Ravenelii* and *C. texensis* in many respects, but the fructifications are much smaller and more numerous than in either of these species, and their various parts are also much smaller and some of the spores are colored.

Specimens examined:

Louisiana: Bohemia, Plaquemines Co., *A. B. Langlois, 864a*, type, in Burt Herb. and also (in U. S. Dept. Ag. Herb.); *A. B. Langlois, 864* (in U. S. Dept. Ag. Herb.).

19. C. fasciculata Schw. ex Berk. & Curtis, Jour. Acad. Nat. Sci. Phila. **3**: 207. 1856. Plate 19. fig. 17.

Cantharellus fasciculatus Schw. Trans. Am. Phil. Soc. N. S. **4**: 153. 1831.—*C. fasciculatus* Schw. in Saccardo, Syll. Fung. **5**: 495. 1887.—*Cyphella fasciculata* Berk. & Curtis, Grevillea **2**: 6. 1873.—*Solenia anomala* Pers. var. *orbicularis* Peck, Rep. N.Y. State Mus. **47**: 168 (42). 1894.—*Cyphella fulva* Berk. & Rav. Grevillea **2**: 5. 1873.—*C. Ravenelii* Saccardo, Syll. Fung. **6**: 672. 1888.—*C. Saccardoi* Sydow, in Saccardo, Syll. Fung. **14**: 233. 1900.—*C. furcata* Berk. & Curtis, Grevillea **2**: 5. 1873.

Type: in Herb. Schweinitz.

Fructifications gregarious, sometimes fascicled, pezizoid, tawny olive; pileus stipitate, cup-shaped, extended vertically or pendulous, tomentose with tawny-olive, even-walled hairs which are flexuous or somewhat spirally curved towards the tips, the margin strongly inrolled; stem short, variable in length, cylindric, tomentose, colored like the pileus; hymenium concave, even, drying olive-buff; spores hyaline, even, cylindric, slightly curved, 7–9 x 2–2½ μ, borne four to a basidium.

Fasciculate clusters about 2 mm. in diameter, 1 mm. high; fructifications ⅓–1 mm. in diameter, 1–2 mm. high; stem ½–1 mm. long, ⅕–½ mm. thick.

On bark of twigs of *Alnus* in swamps and rarely on *Prunus virginiana* and *Pyrus Malus*. Canada and Newfoundland to South Carolina and westward to Wisconsin. Throughout the year, more highly fasciculate from autumn to spring. Common.

This fungus is very common on dead twigs of *Alnus* in swamps. The color is similar to that of *Solenia anomala* but the fructifications are rather larger and more cup-shaped than those of the latter and have the hymenium merely concave rather than lining a tube. The fructifications burst out through the outer bark

either singly or in clusters of from two to twenty individuals more or less connected together at the base. The differences in habit between the extremes of highly fascicled forms and those with fructifications gregarious and largely single, impress one as of specific weight at first and I should like to recognize these extremes as two species but they intergrade too completely. The dated collections which I have seen, indicate that the specimens become highly fasciculate in autumn and winter.

I do not understand why Berkeley attempted authorship for this species. The *C. fasciculata* B. & C. is certainly that of Schweinitz both in description and in fascicled form of types; and as for *C. fulva* B. & Rav., it is noted in the original description that it is the same as *Cantharellus fasciculatus* Schw.

Specimens examined:

Exsiccati: Ellis, N. Am. Fungi, 936, fascicled form; Ell. & Ev., Fung. Col., 1818, fascicled form under the name *C. Ravenelii* Berk.; Shear, N. Y. Fungi, 308, fascicled form under the name *Solenia anomala* (Pers.) Fr. var. *orbicularis*. Pk. Peck det.; Ravenel, Fung. Car. IV., 16, the type distribution of *C. fulva* B. & Rav.; Ravenel, Fung. Am., 129 (bearing spores in abundance); Shear, N. Y. Fungi, 56.

Newfoundland: Headquarters, *B. L. Robinson & H. von Schrenk* (in Mo. Bot. Gard. Herb., 4764 and 43789, the latter communicated by W. G. Farlow); Bay of Islands, *A. C. Waghorne, 127* (in Mo. Bot. Gard. Herb., 42593).

Quebec: Hull, *J. Macoun, 355.*

Ontario: Ottawa, *J. Macoun, 23.*

Maine: *J. Blake* (in Curtis Herb., 6926, and in Kew Herb.).

New Hampshire: Conway, *W. G. Farlow;* North Conway, *W. G. Farlow* (in Mo. Bot. Gard. Herb., 43786); Shelburne, *H. von Schrenk* (in Mo. Bot. Gard. Herb., 4765), *W. G. Farlow* (in Mo. Bot. Gard. Herb., 43787); Franklin Falls, *Mrs. J. B. Harrison,* Ellis, N. Am. Fungi, 936.

Vermont: Middlebury, on *Alnus* and on *Prunus virginiana, E. A. Burt.*

Massachusetts: Newton, *W. G. Farlow* (in Mo. Bot. Gard. Herb., 42591, 42592 and 43788).

New York: *Torrey,* type (in Herb. Schw.); *Sartwell,* cotype and type of *C. fasciculata* B. & C. (in Curtis Herb., 2659, and in

Kew Herb. respectively) and specimen (in Mo. Bot. Gard. Herb., 4937); Ithaca, *G. F. Atkinson;* East Galway, *E. A. Burt;* Keeseville, *C. O. Smith*, Ell. & Ev., Fung. Col., 1818; Alcove, *C. L. Shear*, Shear, N. Y. Fungi, 56 and 308; Albany, *C. H. Peck*, comm. by H. D. House (in Mo. Bot. Gard. Herb., 43821); Karner, *C. H. Peck*, comm. by H. D. House (in Mo. Bot. Gard. Herb., 43820).

South Carolina: *Ravenel, 1683* (in Curtis Herb. and in Kew Herb.), and in Ravenel, Fung. Car. IV., 16; Aiken, *Ravenel*, Ravenel, Fung. Am., 129.

Alabama: *Beaumont*, the cotype and type of *C. furcata* (in Curtis Herb., 4022, and in Kew Herb. respectively).

Wisconsin: Madison, *W. Trelease* (in Mo. Bot. Gard. Herb., 42594).

20. C. conglobata Burt, n. sp. Plate 19. fig. 15.

Type: in Mo. Bot. Gard. Herb. and in Farlow Herb.

Fructifications cespitose, 10–30 together, sessile on a common short trunk which is erumpent through the bark; individual fructifications subglobose, fuscous and glabrous when moist, drying mouse-gray and with the margin inrolled; hymenium concave, black or nearly black; basidia simple, with four sterigmata; spores colorless, even, cylindric, slightly curved, 8–10 x 2½–3μ.

Cluster 1–2 mm. in diameter, emerging about ½ mm. from the bark; cups 400–500 μ broad, nearly as high.

Clusters scattered on small limbs of *Alnus*. New Hampshire and New York. July and September.

The clusters of this curious fungus are distributed at the rate of about 5 or 6 clusters to the square centimeter on what I conclude to have been the under side of a horizontal limb—perhaps a limb prostrate on the ground; for cups in clusters exactly on this presumably under side have the pore central while in the clusters which emerged more obliquely from the limb the cups are somewhat auriform with oblique pore and are arranged in imbricated manner. The outer surface of the cups is composed of irregularly branched and interwoven pale brownish hyphæ about 2 μ in diameter. The substance of the fructifications and common trunk-like base is composed of colorless hyphæ with walls gelatinously modified.

One might regard this fungus as the type species of a new genus distinct from *Cyphella* or *Solenia* by the common central mass on which the individual cups are borne, but in *Cyphella fasciculata* the cups sometimes occur singly and sometimes branching from a common central or basal mass. For this reason it seems best to include the present species in *Cyphella* through its relationship in plan of structure to *C. fasciculata*, from which it is specifically distinct in other respects, however. Both these species are excluded from *Solenia* by their short and globose fructifications and by the absence of a subiculum on the general area over which the clustered fructifications are distributed.

Specimens examined:

New Hampshire: Lower Bartlett, *R. Thaxter*, comm. by W. G. Farlow, 4, type (in Mo. Bot. Gard. Herb., 43806, and in Farlow Herb.).

New York: Adirondack Mts., *C. H. Peck*, comm. by H. D. House (in Coll. N. Y. State and in Mo. Bot. Gard. Herb., 43818); North Elba, *C. H. Peck*, comm. by H. D. House (in Mo. Bot. Gard. Herb., 43819).

21. C. fumosa Cooke, Grevillea **20**: 9. 1891. Plate 19. fig. 11.

Type: in Kew Herb.

Fructifications gregarious, membranaceous, cup-shaped, flexuous, sepia or olive-brown and blackening, even, attenuated below into a very short stipe, or sessile; hymenium even; basidia cylindric-clavate, 20 x 4–5 μ; spores colorless, even, somewhat flattened on one side, 6–8 x 3½–4 μ.

Fructifications 1–2 mm. broad.

On rotting leaves of *Gladiolus*. South Carolina.

Cooke described the spores of this species as globose, 4 μ in diameter, but I found no such spores in my preparation from the type. Spores 6–8 x 3½–4 μ are abundant and are probably the spores of this species, although I could not find any spores still attached to the basidia. I conclude from my microscopical preparations that the fructifications are glabrous.

Specimens examined:

South Carolina: Aiken, *Ravenel, 3071*, type (in Kew Herb.).

SPECIES IMPERFECTLY KNOWN

C. cinereo-fusca Schw. ex Saccardo, Michelia **2**: 303. 1881.

Peziza cinereo-fusca Schw. Schrift. d. Naturforsch. Gesell., Leipzig, **1**: 119. 1822; Fries, Syst. Myc. **2**: 97. 1823.—*Cyphella cinereo-fusca* (Schw.) Sacc. Syll. Fung. **5**: 674. 1888.—*Lachnella cinereo-fusca* (Schw.) Sacc. Syll. Fung. **8**: 399. 1889.

Fructifications minute, gregarious, sessile, externally farinaceous-hirsute and ash-green, the margin incurved; hymenium fuscous-bay.

On decorticated branches of *Cercis*. [North Carolina.]
3 mm. broad. Cups often closed.

—Translation of original description.

I have not seen an authentic specimen of this species nor anything on *Cercis* which seems referable to it. The species is given here on the authority of Saccardo, *l. c.*, who refers to this species a *Cyphella* collected on *Vitis vinifera* near Toulouse, France, by Roumeguere. Saccardo does not state that he made comparison with an authentic specimen from Schweinitz, and he has entered the species in the 'Sylloge Fungorum' in both the *Basidiomycetes* and the *Discomycetes*.

C. Palmarum Berk. & Curtis, (Fung. Cub.) Jour. Linn. Soc. Bot. **10**: 337. 1867.

Type: type and cotype probably in Kew Herb. and Curtis Herb. respectively.

White, pileus cyathiform, externally obscurely pruinose; stem short, tomentose, rather thick.

Scarcely 2 mm. high; stem rather thick for the size of the pileus, often oblique.

On petioles of palms. Cuba. June. *C. Wright, 753.*

—Arranged from original description.

C. Peckii Sacc. Syll. Fung. **6**: 684. 1888.

C. candida Peck, Rep. N. Y. State Mus. **27**: 99. 1875.

Type: in Coll. N. Y. State.

Fructifications scattered or gregarious, membranaceous, soft, obconic, nearly or quite sessile, sometimes deflexed, wholly white, externally tomentose; hairs tapering to a sharp point, rough-walled, 60–70 x 3½ μ.

Fructifications about 1 mm. broad.

On dead stems of ferns, *Osmunda cinnamomea*. New York. September.

The type specimens of this species are immature. I could make out neither distinct asci nor basidia in the hymenium. In a crushed preparation I found one spore, colorless, even, pointed at one end, 6 x 2½ μ. It may have been a basidiospore of this species or it may have been a foreign spore.

Specimens examined:

New York: Forestburgh, *C. H. Peck*, type (in Coll. N. Y. State).

C. perexigua Sacc. Michelia **2**: 136. 1880.

Cups bell-shaped, very short and obliquely stipitate, small, ½–¾ mm. long, thin-membranaceous, internally and externally whitish cinereous, externally minutely puberulent; spores not seen. Appears related to *C. erucæformis* and *cupuliformis* but is one-third as large. . . . On decorticated branches. South Carolina. *Ravenel.*—Translation of original description.

I have not seen the type of *C. perexigua*, which is probably in Saccardo Herb. As basidia and basidiospores have not been found for American specimens, it is uncertain whether this species is a *Cyphella*. Patouillard, Tab. Anal. Fung. 19. *f. 34*. 1883, referred to *C. perexigua* a species of *Cyphella* which he collected at Poligny, France, but that reference is doubtful in the absence of knowledge in regard to basidia and basidiospores for American specimens.

C. pezizoides Zopf, in Morgan, (Myc. Fl. Miami Val.) Jour. Cincinnati Soc. Nat. Hist. **10**: 202. 1888.

Type: probably in the State Univ. of Iowa Herb.

"Fructifications membranaceous, nearly sessile, globose then cup-shaped, clothed externally with long erect white hairs. Hymenium even, brownish; spores obovate, .012–.013 mm. in length.

"On old herbaceous stems; not common, cupule pezizoid, scarcely pedicillate, about half a line in diameter. The long hairs are erect and connivent over the hymenium; they are hyaline and incrusted with crystals of calcium oxalate."

—Original description.

The type is not accessible at present.

C. trachychæta Ell. & Ev. Jour. Myc. **4**: 73. 1888.

Type: in New York Bot. Gard. Herb.

Fructifications gregarious, sessile by a narrow base, white, cup-shaped, clothed outside with appressed hairs; hairs subhyaline, very rough, with a smooth tapering tip 12–15 μ long; hairs paler around the base of the fructification and coarsely roughened by irregularly shaped tubercles, some of which are prolonged into short spines; hymenium nearly white with a slight tinge of slate color; basidia and spores could not be well made out, but the latter are apparently very minute.

Fructifications 300–400μ high and broad, occasionally 1 mm. broad and with the margin distinctly lobed.

On fallen leaves of *Quercus*. Louisiana. July.

The above description is arranged from that originally published. I am under obligation to Dr. Murrill for recently sending to me a portion of the type for study, but the specimen proves too immature to show whether this species is a basidiomycete. The hymenium of this specimen is now pale olive-buff; the hairs are 50–75 x 6 μ, heavily encrusted except near the tips, but I failed to find any hairs roughened by tubercles or bearing spines.

Specimens examined:

Louisiana: *A. B. Langlois, 1424*, type (in N. Y. Bot. Gard. Herb.).

C. Bananæ Cooke, Grevillea **6**: 132. 1878.

Type: probably in Kew Herb.

Fructifications fuliginous or wood-brown, finger-shaped, pendulous-extended behind, glabrous, the margin entire; hymenium white, rugose; spores linear, obtuse, curved, 10–12 x 2½ μ. —Translation of original description.

On dead leaves of *Musa*. Gainesville, Florida. *Ravenel.*

C. filicicola Berk. & Curtis, Grevillea **2**: 5. 1873.

Type: type and cotype probably in Kew Herb. and Curtis Herb. respectively.

Stem very short; cups irregular, sometimes oblique, externally very obscurely tomentose, umber.

On dead fern. North Carolina. Curtis Herb., 4934, type.

The above contains all the items of the original description; I overlooked this species when studying in Curtis Herb. and in Kew Herb.

C. musæcola Berk. & Curtis, Jour. Linn. Soc. Bot. **10**: 337. 1867.

Type: type and cotype in Kew Herb. and Curtis Herb. respectively.

Pileus crucible-form, pallid purple, with very short stem or sessile, externally tomentose; hymenium luteus (cadmium-yellow). —Translation of original description.

About 2 mm. across.

On sheaths of plantain leaves. Cuba. *C. Wright, 751.*

By the kindness of Dr. Farlow I have been permitted to examine a specimen from the type collection. I fail to find any fructifications of a *Cyphella* present. A leaf-spot fungus has caused some dark purple discolorations 1–2 mm. in diameter at various points in the surface of the leaf.

Specimens examined:

Cuba: *C. Wright, 751*, comm. by W. G. Farlow (in Mo. Bot. Gard. Herb., 43790).

EXCLUDED SPECIES

C. convoluta Cooke, (Fungi of Texas) Ann. N. Y. Acad. Sci. **1**: 179. 1878.

Type: In Kew Herb.

"Scattered, cup-shaped, then flattened, 1 to 2 mm. wide, margin membranaceous, involute, externally white, internally fleshy-red; spores oblong (.007 mm. long).

"On trunks. Ravenel (295)."—The original description.

I examined the type of this fungus, which was collected at Houston, Texas, and do not regard it as a *Cyphella*. The "basidia" are filiform and only 1-spored; spores are abundant, hyaline, even, 4–5 x 2–2½ μ.

C. Cupressi Schw. ex Fries, Epicr. 567. 1836–1838.

Merulius Cupressi Schweinitz, Schrift d. Naturforsch. Gesell., Leipzig, **1**: 92. 1822.

This species is an insect gall, not a Basidiomycete. Its true nature seems to have been first pointed out by Berkeley & Curtis, Jour. Acad. Nat. Sci. Phila. **3**: 207. 1856.

C. subcyanea Ell. & Ev. Jour. Myc. **2**: 37. 1885.

As this species is not mentioned in Saccardo's 'Sylloge Fungorum' and as the early numbers of the Journal of Mycology are rare, I quote the original description as follows:

"On living leaves of Sabal Palmetto, Louisiana, Nov. 1885. Rev. A. B. Langlois, No. 57. Shallow cup-shaped, thin, substipitate, oblique, less than 1 mm. across, whitish and nearly smooth outside, hymenium bluish or lead colored. Spores filiform multinucleate, upper end thickened, curved into a semicircle, 40–60 μ long by $1\frac{1}{2}$ μ thick, on short (11–12 x $1\frac{1}{2}$–2 μ) subcylindrical sporophores, which are a little thickened below."

This species was distributed in 1891 in Ell. & Ev., N. Am. Fungi, 2602, the specimens having been collected on living stems of *Smilax* in Louisiana by Mr. Langlois. Mr. Langlois communicated to me still better specimens on dead canes of *Arundinaria*. The fructifications occur scattered here and there in grayish areas 2–4 mm. long by $\frac{1}{2}$–1 mm. broad on the surface of the stems. Dr. Farlow informs me in a letter as the proofs are at hand that the above species is the lichen *Heterothecium Augustinii* Tuckm.

(To be continued.)

Explanation of Plate

PLATE 19

The figures of this plate have been reproduced natural size from photographs of dried herbarium specimens except in the cases noted otherwise.

Fig. 1. *Craterellus borealis*. From the type specimen collected at Gready Island, Labrador, by Owen Bryant.

Fig. 2. *Cyphella galeata*. From photograph, natural size, of the figure in Flor. Dan. *pl. 2027. f. 1.*

Fig. 3. *C. muscigena*. The two figures on the left are from specimens collected at Floodwood, New York, by E. A. Burt; the two on the right are from the type collection of *Craterellus Pogonati* collected at South Windsor, Connecticut, by C. C. Hanmer, 1956.

Fig. 4. *C. capula*. From photograph, natural size, of the figure in Fung. Dan. 2: *pl. 22.*

Fig. 5. *C. minutissima*. From the type specimens collected at Chocorua, New Hampshire, by W. G. Farlow, 3. Drawings of, *a*, two fructifications, x14; *b*, spores, x510; *c*, a hair from outer wall of fructification, x510.

Fig. 6. *C. Langloisii*. From the type specimens collected at St. Martinville, Louisiana, by A. B. Langlois, cz. Drawings of, *a*, two fructifications, x17; *b*, spores, x510; *c*, a hair from outer wall of fructification, x510.

Fig. 7. *C. porrigens*. From the type specimens collected at Cinchona, Jamaica, by W. A. and Edna L. Murrill, 607. Drawings greatly enlarged of, *a*, a fructification showing attachment to a piece of woody stem; *b*, diagrammatic section of the same fructification; *c*, two spores, x510.

Fig. 8. *C. caricina*. Three spores, x510, from the type specimen collected at Verona, New York, by C. H. Peck.

Fig. 9. *C. cupulæformis*. From the specimens in Ravenel, Fung. Am., 224, collected at Darien, Georgia, by Ravenel. Drawings of, *a*, two fructifications, x6; *b*, a basidium, x510; *c*, four spores, x510.

Fig. 10. *C. texensis*. Three spores, x510, from the type specimens collected in Texas, by C. Wright, 3779.

Fig. 11. *C. fumosa*. Three spores, x510, from the type specimens collected at Aiken, South Carolina, by Ravenel, 3071.

Fig. 12. *C. mellea*. From the type specimens collected at Bohemia, Louisiana, by A. B. Langlois, 864a. Photograph, *a*, of a piece of wood bearing many fructifications, and drawings of, *b*, median longitudinal section of a fructification, x60; *c*, three spores, x510; *d*, a hair from outer wall of fructification, x510.

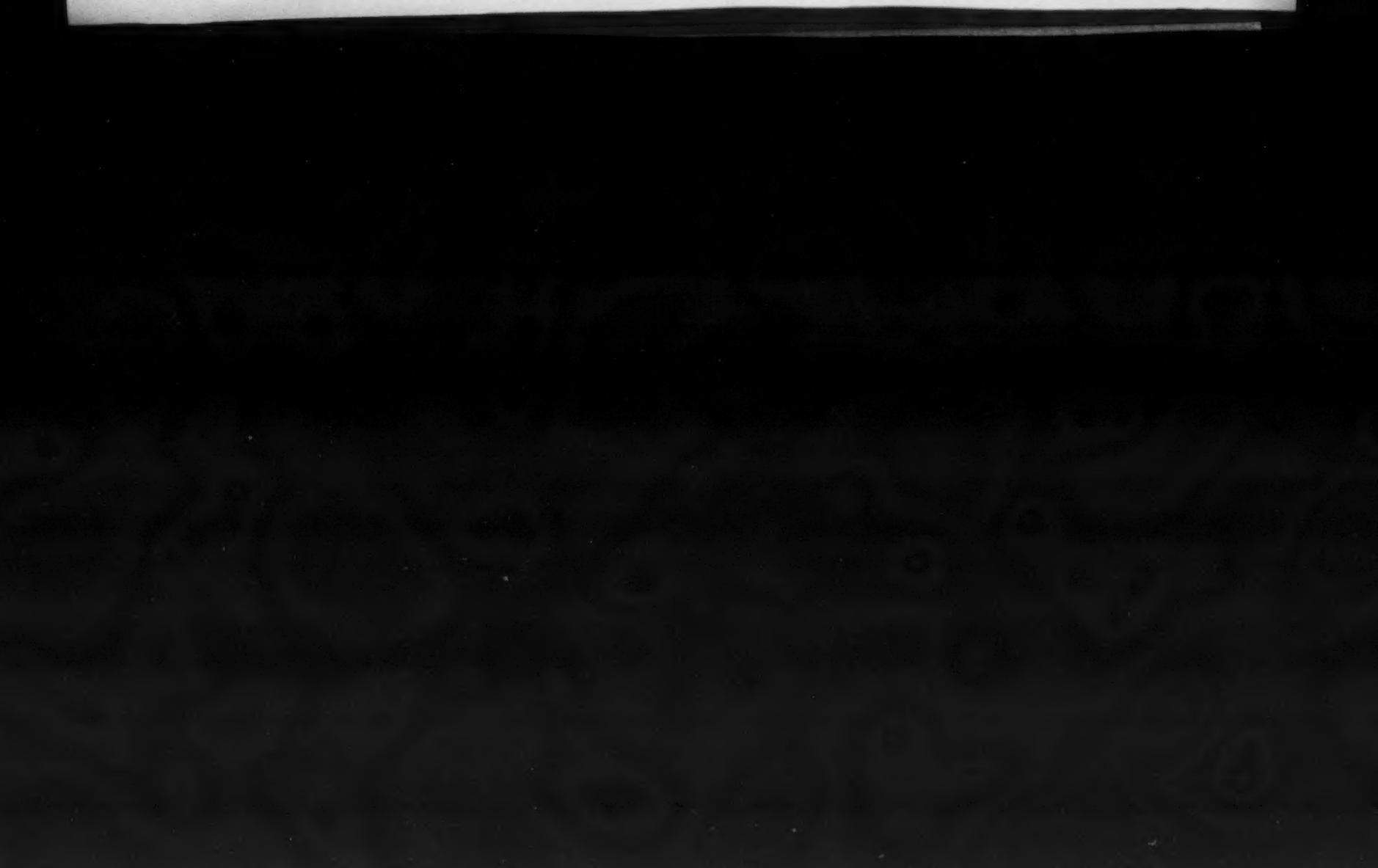
Fig. 13. *C. villosa*. Three spores, x510, from the specimens in Krieger, Fung. Sax., 1457, collected at Königstein, Germany, by W. Krieger.

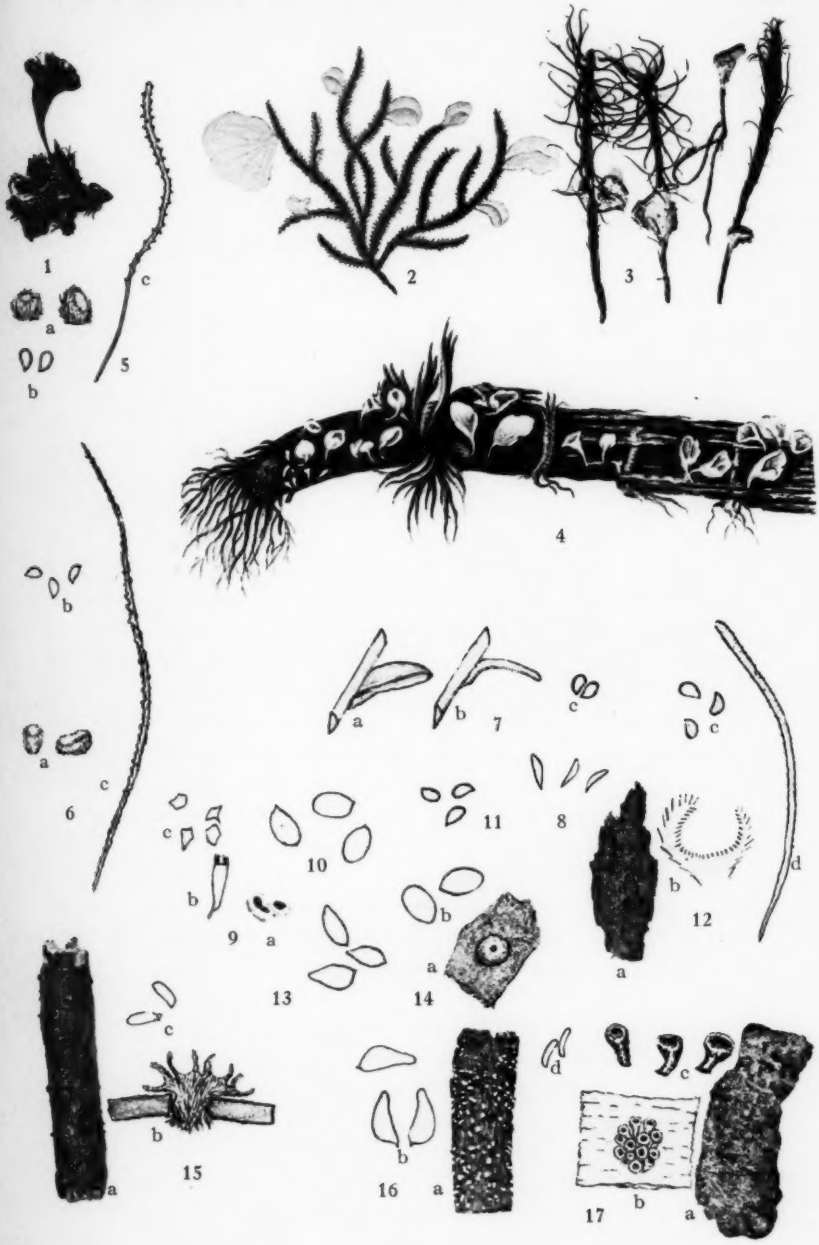
Fig. 14. *C. Ravenelii*. From the specimens in Ravenel, Fung. Am., 130, collected at Aiken, South Carolina, by Ravenel. Drawings of, *a*, a fructification on a piece of bark, x6; *b*, two spores, x510.

Fig. 15. *C. conglobata*. From the type specimens collected at Lower Bartlett, New Hampshire, by R. Thaxter. Photograph, *a*, of a portion of a branch bearing many clusters of fructifications, and drawings of, *b*, a median vertical section through one cluster of fructifications, x6; *c*, two spores, x510.

Fig. 16. *C. Tiliæ*. From specimens collected at Middlebury, Vermont, by E. A. Burt. Photograph of, *a*, a piece of limb bearing many fructifications, and drawing of, *b*, three spores, x510.

Fig. 17. *C. fasciculata*. From specimens collected at Ottawa, Canada, by J. Macoun, 23. Photograph of, *a*, a piece of bark bearing many fructifications, and drawings of, *b*, a cluster of fructifications, x6; *c*, three fructifications, x10; *d*, two spores, x510.





BURT—THELEPHORACEAE OF NORTH AMERICA

1. CRATERELLUS BOREALIS.—2. CYPHELLA GALEATA.—3. C. MUSCIGENA.—4. C. CAPULA.—5. C. MINUTISSIMA.—6. C. LANGLOISII.—7. C. PORRIGENS.—8. C. CARICINA.—9. C. CUPULAEFORMIS.—10 C. TEXENSIS.—11. C. FUMOSA.—12. C. MELLEA.—13. C. VILLOSA.—14. C. RAVENELII.—15. C. CONGLOBATA.—16. C. TILIAE.—17. C. FASCICULATA.

COCKAYNE, BOSTON.

SOME ŒNOTHERAS FROM CHESHIRE AND LANCASHIRE[1]

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OBSERVATIONS

Œnotheras are known to have been naturalized on the Lancashire coast since 1805, and probably existed there much earlier. They are now found on the sand dunes in many places, from Liverpool and the vicinity of Birkenhead northwards along the coast to Southport and Blackpool. They are notably abundant at St. Anne's-on-Sea, where they have been described by Bailey ('07), and in certain localities near Birkenhead (MacDougal '07). I have grown, chiefly at the Missouri Botanical Garden, extensive cultures of plants from the latter region, from seeds obtained through Dr. D. T. MacDougal in 1907, and have visited the Lancashire coast in 1910 and again in July, 1914, when I travelled along the coast from Liverpool to Southport and from Blackpool to St. Anne's. The œnotheras everywhere appear to be spreading, although children gather the flowering shoots in armfuls. The profusion of individuals is greatest at St. Anne's, where acres of waste land in the town are dotted over with them. Smaller colonies occur in various other places, notably at Bidston Junction, near Hightown and at Formby. Small groups of half a dozen plants are sometimes found in isolated places on the dunes.

I will first refer to some of these colonies as I saw them during my last visit, and will then describe a few of the many forms observed in cultures.

The Bidston Junction colony, referred to in MacDougal ('07), is a compact and almost uniform one occurring on a triangular piece of ground between railway tracks, about five minutes' walk down the foot path from Bidston Junction towards Wallersy, on the right-hand side. Some years ago, quantities of sand were dumped here from the coast between Wallersy and New Brighton. Soil from neighboring gardens has also been

[1] Issued January 30, 1915.

deposited here, and the advent of the œnotheras is doubtless from one or other of these two sources.

The plants closely resemble the "Isle of Wight" race of *Œ. Lamarckiana* (to be described in a book now in process of publication) and the species as it generally appears in English gardens. The rosettes in this colony differ in having green midribs (both dorsally and ventrally), or pink midribs (both dorsally and ventrally), but the depth of red varies. The same applies to the stem-leaves. This is curiously different from other races, such as *Œ.* mut. *rubrinervis*, in which the midribs are red dorsally and green ventrally. The rosette leaves are usually nearly or quite smooth, but some may be crinkled. The plants were short, their average height being about twenty-two inches, though some reached a height of over three feet. The stems bear many red papillæ. The smaller plants were unbranched, the lower stem-leaves being closely crinkled and curled while the upper leaves and bracts are often quite smooth. A peculiarity of the race was the irregular disposition on the stem of much-crinkled and nearly smooth leaves, without gradual transitions between them such as usually occur in de Vries's race of *Œ. Lamarckiana*. Not infrequently crinkled and smooth leaves alternate. The buds have fewer long hairs than in the above mentioned race, and the sepals have uniformly the red color pattern 5–7 of *Œ.* mut. *rubrinervis*, though they vary somewhat in depth of shade. The dimensions of the flowers were as follows: bud cone 50 mm., hypanthium 43 mm., ovary 11 mm., diameter of cone at base 11 mm., length of petals 50 mm., width 60 mm. One plant was identical with the race of de Vries, except in its larger flowers, reddish sepals and fewer long hairs. In most plants there is also a strong distinction between the smooth and crinkled leaves.

This colony differs, therefore, in minor peculiarities from any race of *Œ. Lamarckiana* previously observed, and it exhibits a relatively narrow range of variation.

Along the electric railway tracks north of Liverpool, between Crosby and Hightown, an equally extensive and uniform colony of *Œ. biennis* was found. Thousands of plants, in flower and rosettes, were growing on uncultivated land with a nearly pure sandy soil, behind the coast range of sand hills in a long narrow

area near a clump of small poplar trees. Near the upper end of this area the plants differed in having smaller flowers (petals 21 mm.) and narrow leaves (20 mm. broad). The remainder of the plants had somewhat larger flowers (petals usually 25–27 mm. long), and broader leaves (extreme width 50 mm.).[1] This was almost the only variation observed, and the race comes very close to the type of *Œ. biennis* L. The dimensions of the buds were as follows: bud cone 20 mm., hypanthium 25 mm., ovary 11 mm., anthers surrounding the stigma. The rosette-leaves and stem-leaves *all* have red midribs both dorsally and ventrally. On the same stem some leaves are smooth and some more or less crinkled. The buds are green, devoid of red, with some long hairs, and there are no red papillæ on any part of the plant. Some of the larger plants are well-branched and with very stout stems, a huge pith and a very narrow ring of wood.

This colony is even more uniform than the previous one, and must have originated from one or a very few plants.

Small colonies of *Œ. biennis* were seen at Formby, near the station and in other places. A race of *Œ. Lamarckiana* also grows here on the dunes, although I did not succeed in finding the spot, but local gardens cultivate it. The species is depicted, however, in a rose window erected in St. Luke's Church, Formby, in 1898, containing representative plants of the local flora. The central portion of the window is divided hexagonally and in the six sections the evening primrose alternates with the sea holly. The foliage and large flowers of the former are distinctly shown. Around the margin of the window are *Pyrola rotundifolia* and irises.

At Blundell Sands, near Crosby, a small colony of *Œ. Lamarckiana* was seen on waste ground, and again on the extensive sand dunes between Birkdale and Ainsdale, near Southport. In the latter case there were only three plants, and these possessed red sepals, color pattern 7, green midribs, crinkled leaves, and about $\frac{n}{4}$ long hairs.

By far the greatest abundance of plants was found at St.

[1] These apparently correspond to *Lysimachia virginiana altera, foliis latioribus, floribus luteis majoribus*, Cat. Altdorff. See Gates, R. R. The mutation factor in evolution [pp. 61, 65, 70]. Macmillan. London.

Anne's. In addition to those in the town, which are in great profusion, numerous smaller colonies are scattered along the adjacent sand dunes. The great majority of the plants is the same as at Bidston Junction except in the crinkling of the leaves, having foliage closely resembling that of de Vries's *Œ. Lamarckiana*, midribs red both above and below, the red absent in some individuals. The flower measurements were, length of petals 50 mm., hypanthium 45 mm., ovary 10 mm. Several aberrant individuals were also observed. One dwarf mutant was found growing in the shade of a large plant. It resembled *Œ.* mut. *nanella* but had red midribs. One large rosette, having leaves very obtuse and pale pink midribs, probably belonged to *Œ.* mut. *brevistylis*. A number of plants represented a shorter spindling type with very narrow rosette-leaves (18 mm. wide x 14 cm. long). Another plant belonged to a new type, large and branching with thicker, narrower leaves (33 mm. x 13 cm.), stiffer and narrowly pointed, midribs white, and later in beginning to flower (buds only half developed, July 16).

In addition to these probable mutants, there were found in one field a few plants of a small-flowered *Œ. biennis* race growing with the *Œ. Lamarckiana*. They differed from the latter only in the small flowers (petals 22 mm., style short), and hence were unlike the *Œ. biennis* race previously described. Near by were also found plants, evidently hybrids of these two races, with petals about 30 mm. in length.

CULTURES

Some of my cultures of œnotheras from near Birkenhead have already been described in a general way (Gates, '13). Here I wish to describe a few of these forms in detail, and also to refer to my experiments with plants from St. Anne's. I have not seen the colony from which the Birkenhead seeds were obtained, but it evidently contains a great profusion of forms belonging to both *Œ. Lamarckiana* and *Œ. grandiflora*, while all the colonies I have observed have a much more uniform population.

Œ. MULTIFLORA

One of the distinct races in these cultures I have already (Gates, '10) referred to as *Œ. multiflora*. It is descended

entirely from one individual from a sowing of Birkenhead seeds at Woods Hole in 1908. From this individual an F_1 of 376 plants was grown in the two following years. About 4 per cent of these plants showed virescence, as described in the above paper. In 1910 a total of 297 plants were grown, most of which belonged to the F_2. An F_3 numbering 193 plants in nine families was grown in 1911, and an F_4 of 356 plants in eight families in 1912. The plants were by no means uniform, and they varied considerably from year to year. The description given is therefore a generalized one, and the condition of variability is no doubt similar to that of many wild "species." By isolating the offspring of a larger number of individuals, no doubt this variation could have been further analyzed, but more pressing problems have prevented this being done.

Plate 20 fig. 1 shows a typical rosette of my 1909 culture, pl. 20 fig. 3 the full-grown plant, and pl. 20 fig. 6 a flowering shoot on a larger scale. Specimens of this species are preserved in the herbarium of the Missouri Botanical Garden from my cultures of 1909, and in the British Museum (Natural History) from the 1912 families.

Description: Rosette of few leaves, broad and obtuse-pointed, somewhat crinkled. Full-grown plant pyramidal in outline, with lateral branches and persisting rosette leaves. Average height about 88 cm. Stems slender, stem-leaves smooth, lanceolate, bracts broadly cuneate at base with a very short petiole, tip long-pointed, more or less curled, margin irregularly repand-denticulate. Inflorescence compact, flowers numerous; buds squarish, slender with very long and slender sepal tips, sepals thin, bud cone 35 mm. long, hypanthium 37 mm., sepal tips 7 mm., ovary 10 mm., petals 43 mm., very broad and overlapping when flower is open, long hairs fairly numerous. Few red papillæ on main stem, many on side branches. In 1909 culture the buds were all green, but in 1911 they had the red color pattern of *Œ.* mut. *rubrinervis* and the stems were also reddish.

As regards variations, virescence appeared in the first two generations but not in the last two. On the other hand, a var. *elliptica* was first observed in F_2 and further studied in F_3 and F_4. This variety differs essentially in being smaller and having narrower leaves and narrow, more or less elliptical petals. Plate

20 fig. 2 shows a rosette of this variety in F_3 (1911). One family of 50 plants in 1910 contained 5 of this variety. Usually these plants show partial variability, some flowers having broad petals and others narrow and elliptical ones. Even the different petals of the same flower may show these differences. Flowers with elliptical petals are invariably smaller and are frequently found on the side branches when those of the central stem have normal petals. Hence this variation may be a matter of strength in the plant. The variation, from petals which are broad and truncate or emarginate to those which are narrow and elliptical, or even almost cruciate, is continuous. Thus on one plant in 1911, the dimensions of the petals in two flowers were as follows:

Flower 1. Petal (1) 31 mm. x 21 mm.
Petal (2) 25 mm. x 17 mm.
Petal (3) 20 mm. x 12 mm.
Petal (4) 22 mm. x 13 mm.

In this flower the petals are very small and very unequal in size but all elliptical.

Flower 2. Petal (1) 38 mm. x 39 mm.
Petal (2) 37 mm. x 37 mm.
Petal (3) 34 mm. x 36 mm.
Petal (4) 35 mm. x 36 mm.

In this flower the petals were nearly full size, nearly equal, and scarcely elliptical.

The inheritance of this condition is on a sliding scale, plants with only broad petals giving some offspring with elliptical petals, and plants with elliptical petals giving some offspring having only broad petals, though in the latter case the plants bearing elliptical petals are more numerous than in the former case. Thus the F_3 family from a normal plant contained 14 specimens having broad petals only and 15 having some elliptical petals; while another F_3 family of 44 plants derived from a plant having elliptical petals contained only 5 plants having exclusively broad petals. These peculiarities of the petals are probably to a large extent under the control of environmental features such as temperature and water supply.

The difference between broad and narrow leaves is much sharper. Thus in my F_4 cultures in 1912 certain families contain

both the broad or normal type (pl. 20 fig. 5) and the *elliptica* variety (pl. 20 fig. 4). The latter had a number of flowers with elliptical petals and it also had a different method of branching. Plate 21 fig. 12 is representative of a uniform F_4 culture of 49 plants of the variety *elliptica*. This photograph is taken on a larger scale, and the nodding of the stem is merely due to wilting. This differs from *typica* (pl. 20 fig. 5) constantly in having narrower leaves and short branches, as well as in the occasional elliptical flowers which appear to be largely under environmental control.

The variability of this race is therefore as interesting as are the features, such as the general bud and leaf characters, in which it is constant. The fact should also be mentioned that a *lata*-like mutant, doubtless having 15 chromosomes, appeared in the F_4 generation, and also a mutant resembling *Œ.* mut. *albida*.

Œ. RUBRINERVOIDES

This race resembles *Œ.* mut. *rubrinervis* in many features, and yet differs from it constantly throughout. I have previously referred to this Birkenhead race as No. 25 (Gates, '11, p. 350) and studied the variation of the red stripes on the buds. In all, 1968 plants of this race have been grown in the years 1909–1912, so that four generations of offspring from a single individual have been cultivated. An illustration of that individual has already been published (Gates, '12, pl. 3). One family of offspring was grown in 1909, two in 1910, eight in 1911 and nine in 1912. Usually the variability of families progressively decreased, since each family was derived from the selfing of one individual of the previous generation. The discussion of the precise ancestry of this race is of course out of the question, but its characters bear nearly though not quite the same relation to the *Œ. Lamarckiana* from this region that the *Lamarckiana* and *rubrinervis* of de Vries's cultures bear to each other.

The 1909 family, or F_1, numbered 111 plants. Plate 21 fig. 8 shows one of these as a rosette. The leaves are narrower and more pointed than in mut. *rubrinervis*, and nearly smooth. About 20 of the plants in this culture omitted the rosette stage altogether and shot up a stem directly from the seedling stage (pl. 20 fig. 7). A normal mature plant of this family is shown

in pl. 21 fig. 11. It will be seen that there is no indication of a rosette, and the branching is quite different from that of *Œ.* mut. *rubrinervis*. In many cases, however, a rosette is formed. When the rosette is omitted the branching is changed. Plate 21 fig. 10 shows on a larger scale another individual in flower. The stem-leaves differ from those of *Œ.* mut. *rubrinervis* in being narrower, more pointed and smoother.

In this race the red papillæ on the stem were very numerous, and the buds likewise were slightly more red than in *Œ.* mut. *rubrinervis*. The modal color pattern of the whole population was *5* as in *Œ.* mut. *rubrinervis*, but plants with their mode at *7* were much more numerous than in the latter (see Gates, '11, p. 351). The race as a whole inherited the capacity for producing a slightly greater amount of pigment. The ovary usually bore many long hairs arising from red papillæ; on the hypanthium were few long hairs from slight green mounds; and on the bud cone scattered long hairs from conspicuous red papillæ. In occasional buds, when the color pattern was only *3*, the green papillæ were more numerous. In addition to the color pattern of the sepals there was usually weak red on the hypanthium.[1]

The same conditions as regards pigmentation have been maintained in later generations. The plants were, however, by no means uniform in all respects, and this was not to be expected since they were derived from one individual of a freely intercrossing population. Plate 21 fig. 9 represents a rosette of one of the F_2 plants. The latter differs obviously from the one represented in pl. 21 fig. 8, but the race retained in this and subsequent generations the long, narrow, smoothish leaves as well as the pigmentation. The various F_3 and F_4 families, each derived from a selfed individual, produced sub-races differing more of less from each other and varying within narrower limits. It does not appear that the Mendelian theory of the sorting out of factors, or "genes," affords an adequate explanation of all these phenomena.

[1] Since this condition of bud-pigmentation resembles that obtained in certain F_1 and F_2 hybrids of *Œ.* mut. *rubricalyx* and *Œ. grandiflora* (see Gates '14), it is possible that it may have arisen in a similar way, i. e., by the appearance of a red-budded mutation which subsequently crossed with other species, in which crosses some blending of pigmentation occurred giving rise to the present condition.

Œ. TARDIFLORA

This name I have used for another race having many peculiarities and showing more resemblance to *Œ. grandiflora* in its flowers and foliage. It is race No. 52 from the same source as the above. A single individual produced in 1909 nineteen plants which were fairly uniform. The rosettes contained only a few leaves, but large plants were formed, one of which is shown in pl. 22 fig. 17. Although this photograph was taken on August 21, the plants with one exception had not begun to flower. The leaves resembled those of *Œ. grandiflora*. They were large with long and acute tips, tapering to the bases, often bearing reddish blotches, sometimes much curled, somewhat crinkled along the midrib. The margin was conspicuously serrately toothed (see pl. 22 fig. 17). At the end of the season (September) these plants came into bloom, and pl. 22 fig. 20 shows a plant photographed on October 2. The buds resembled those of *Œ. grandiflora* but were small. The bud cones were pointed, smooth and rounded, the petals slightly larger than in *Œ. biennis*, or in a few cases much larger. The petals were also deeply emarginate, strongly cuneate and narrow; and the bracts were very small, narrowly lanceolate and yellowish, giving a peculiar appearance to the flowering shoot. The margins of the bracts were nearly entire or in some cases distantly denticulate.

The offspring of the plant in pl. 22 fig. 20 were grown and showed the same peculiarities. The race has not been cultivated further. It was doubtless of hybrid origin and was more nearly allied to *Œ. grandiflora* than to the *Lamarckiana* complex.

Œ. RUBRITINCTA

Reference may be made to one further race which was known as "type M." It originated from one plant in a sowing of the Birkenhead seeds in 1909. It will be understood that scarcely two plants from this sowing were alike, but some were much more distinct than others. The plant in question was a handsome one with very narrow leaves and bright red midribs. Its offspring, grown in 1911, were lost with the exception of one plant which was the same as the parent. It is shown in pl. 22 fig. 16. The basal leaves were very long with long petioles, the stem leaves very narrow, smooth, with margin closely repand-

denticulate, blade narrowing gradually to a very short petiole, midribs and petioles bright red dorsally and ventrally; lowermost bracts 17 mm. in width by 9 cm. in length, upper bracts 11 mm. wide by 58 mm. in length. The buds most resemble those of *Œ. grandiflora*, being nearly devoid of long hairs, slender and somewhat rounded, with setaceous sepal tips and some red on the sepals; length of petals 32 mm., hypanthium 43 mm., sepal tips 9 mm., ovary 10 mm.

In 1912 three families of F_2 offspring, numbering in all 236 plants, were grown from the plant just described. All three families agreed in containing several types exhibiting a remarkable degree of variability.

An attempt was made to place the plants in five classes, but the categories overlapped and made classification for the most part impossible. The majority of the plants resembled the parent individual in their main features but they varied enormously in width of leaf from broad (21 mm.) to very narrow (8–6.5 mm.). These conditions were connected by intermediates, and, moreover, there were considerable variations within the individual, one branch with very narrow leaves being found on a plant with broad leaves. In addition to these variants, the three families contained 35 dwarfs, or 14.8 per cent, and the latter varied in leaf-width in the same remarkable manner. The dwarfs agreed only in having short internodes. Two of them are shown in pl. 21 figs. 13, 14, the former having narrow leaves and extremely short internodes, the leaves of the latter being quite linear. The plant would never be taken for an œnothera.

The advent of a large percentage of dwarfs in this family is similar to their occurrence in other *Œ. grandiflora* races from that locality (see Gates, '14, p. 246). The precise manner in which this capacity for producing dwarfs is inherited, is a difficult question which need not be considered here, particularly as it has been discussed elsewhere (Gates, '14).

Plate 22 fig. 15 represents one of the *Lamarckiana*-like rosettes from this source, grown in 1909. Others approached de Vries's race more closely, to the point of identity. Plate 22 figs. 18, 19 represent selected rosette-leaves taken from this culture to show the range of types exhibited. Such leaves as the

two on the right in pl. 22 fig. 18 were greatly overgrown and were far larger than ever appear even in *Œ.* mut. *gigas*. These forms have not been sufficiently studied since to give an adequate account of them.

It will be obvious that the forms described here under the names *multiflora*, *multiflora elliptica*, *rubrinervoides*, *tardiflora* and *rubritincta* are not pure species or even true-breeding races. They are undoubtedly as diverse from each other as average species, however, and many systematic species if bred experimentally would probably not breed true within narrower limits than these races have done. One feature of interest attaching to these races is the fact that the main type persists essentially unchanged, though various mutants and heterozygous forms are thrown off. The behavior is not, in the main, like the Mendelian process of recombination. Repeated selfing of each race usually decreases its variability by eliminating various hybrid elements. But this process does not extend to the basal differences between the races, which, as we have seen, remain as unlike as they were before. In this aspect the hereditary behavior of these races resembles that of *Œ. Lamarckiana*. But there are a number of differences which I need not fully consider. Thus *Œ. multiflora* gives rise to its variety *elliptica* much as though it were split off from a heterozygous condition, and the variability of *rubritincta* in leaf-width, as well as its production of numerous dwarfs, is unlike anything in the behavior of *Œ. Lamarckiana*.

Many other equally distinct types were derived from this locality (see, e. g., pl. 22 figs. 18, 19), but they have not been cultivated in subsequent generations.

Œ. LAMARCKIANA FROM ST. ANNE'S

In 1910 I obtained seeds from a colony of *Œ. Lamarckiana* growing by the Manchester Children's Hospital Convalescent Home, at St. Anne's-on-Sea. Many of these were found in later cultures to agree exactly with the *Lamarckiana* of de Vries except in the red color pattern of the sepals. I was formerly inclined to lay little stress on this difference but there is no doubt that it is inherited. The fact therefore remains that a precise duplicate for de Vries's race of *Œ. Lamarckiana* is relatively

infrequent on the Lancashire coast, although many forms approach it very closely and differ only in this one feature. As will be seen below, certain other plants agreed with de Vries's *Lamarckiana* except in the shape of the buds.

In 1911 a sowing of the seeds yielded 22 plants. The rosettes were for the most part uniform and very similar to *Œ. Lamarckiana*, two, however, having red midribs and lighter green leaves (*rubrinervis* type). One plant was aberrant, resembling *Œ.* mut. *semilata* in its buds, which were, however, small as in *Œ. biennis*. The bud cone was also somewhat rounded and barrel-shaped, length of ovary 11 mm., hypanthium 37 mm., cone 19 mm., petals 22 mm., style short so that anthers surround base of stigma. The features of this plant make it scarcely likely that it arose as a hybrid. It produced plenty of pollen and seeds.

Another sowing of these seeds in 1912 yielded 140 plants, which included one mut. *lata* with bad pollen (doubtless having 15 chromosomes) and one variegated *Lamarckiana* plant. The variegation was noticed when the plant was a young seedling. It reached maturity and proved to be a periclinal chimæra. Nearly all the leaves were variegated green and yellow. Many leaves were green bordered with yellow, showing the absence of chloroplasts from the epidermal and probably also the hypodermal layer. Occasional leaves were almost entirely yellow, and some were yellow on one side of the midrib and green on the other. There were also broad white bands on the margin of the sepals. The pollen was abundant and plenty of seeds were set.

Two sowings of seeds from this plant were made in 1912. The seeds numbered respectively 121 and 145. Only two seeds in one pan were observed to germinate, and the seedlings quickly died, probably from lack of chlorophyll. Regarding the origin of this periclinal mutation, it would appear to have originated in the embryo after fertilization through the loss of chloroplasts from the outer layers of the growing point.

The foliage in the rest of the culture agreed with the type of *Œ. Lamarckiana*. One plant differed in having stem-leaves more or less pointed at the base, not crinkled, midribs pink, and smaller flowers (petals 29 mm. long x 38 mm. broad, style short, buds

squarish). Two other plants agreed exactly with *Œ. Lamarckiana* except in the buds. The petals were 35 mm. long x 48 mm. broad, emarginate, anthers reaching nearly to top of stigma lobes, sepals green and with the same pubescence as in *Œ. Lamarckiana*, from which these two plants therefore differed only in the somewhat smaller flowers and shorter style. One mut. *nanella* also occurred in this culture, and several other slightly aberrant individuals, including a plant with broadly elliptical foliage. The "*Lamarckiana* foliage" was also more variable than in cultures from de Vries, this no doubt being due to the continued inbreeding in the latter case.

It will be understood that the new forms described here are scarcely to be looked upon as "new species" according to the usual interpretation at the present time. They merely represent a partial analysis of a complex interbreeding colony of forms, and their variability is one of their most interesting features. Nearly all if not all the differences observed are inherited, however, and the mutations can in many instances be separated from the characters arising through hybridization. The forms are, moreover, as distinct from each other as many species of *Œnothera*.

In conclusion, I am indebted to the Missouri Botanical Garden and the John Innes Horticultural Institution for the facilities provided for growing the plants, and to Mr. E. J. Allard for several of the photographs. A portion of the expenses of my second visit to Lancashire was defrayed by a grant from the Royal Society.

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Explanation of Plate

PLATE 20

Fig. 1. *Œ. multiflora*, rosette, 1909.
Fig. 2. *Œ. multiflora elliptica*, rosette, 1911.
Fig. 3. *Œ. multiflora*, full-grown plant, 1909.
Fig. 4. *Œ. multiflora elliptica*, 1912.
Fig. 5. *Œ. multiflora*, 1912.
Fig. 6. *Œ. multiflora*, flowering shoot, 1909.
Fig. 7. *Œ. rubrinervoides*, young plantlet showing absence of rosette, 1909.

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GATES—OENOTHERAS

COCKAYNE, BOSTON.

Explanation of Plate

PLATE 21

Fig. 8. *Œ. rubrinervoides*, rosette, 1909.
Fig. 9. *Œ. rubrinervoides*, rosette, 1910.
Fig. 10. *Œ. rubrinervoides*, showing nearly smooth, pointed leaves, 1909.
Fig. 11. *Œ. rubrinervoides*, no rosette, 1909.
Fig. 12. *Œ. multiflora elliptica*, 1912. (Tip of plant drooped from wilting.)
Fig. 13. Linear-leaved dwarf in offspring of *Œ. rubritincta*, 1912.
Fig. 14. Dwarf offspring of *Œ. rubritincta*, 1912.

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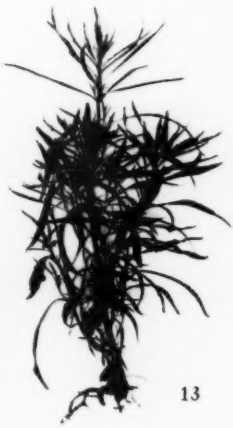

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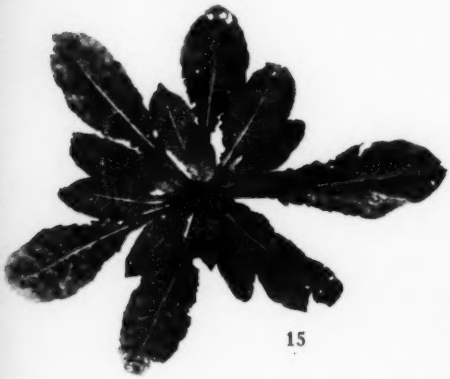
GATES—OENOTHERAS

Explanation of Plate

PLATE 22

Fig. 15. *Œ. Lamarckiana*-like rosette, 1909.
Fig. 16. *Œ. rubritincta*, 1911.
Fig. 17. *Œ. tardiflora*, showing serrated leaves and absence of flowers, August 21, 1909.
Fig. 18. Selected leaves from various rosettes, 1909.
Fig. 19. Selected leaves from various rosettes, 1909.
Fig. 20. *Œ. tardiflora*, showing late appearance of buds, October 2, 1909.



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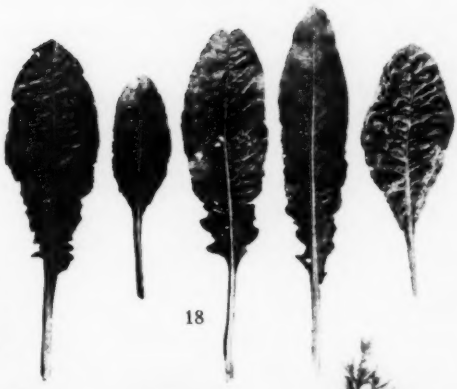

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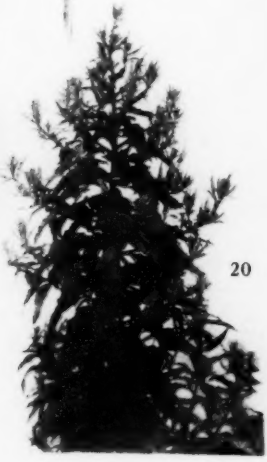

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GATES—OENOTHERAS

COCKAYNE, BOSTON.

A TEXAN SPECIES OF MEGAPTERIUM[1]

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While looking over some material in the herbarium of the Missouri Botanical Garden, a sheet was found containing three specimens which were so distinctive that it seemed desirable to describe them. The interest in them was enhanced by the fact that one of the specimens differs strikingly from the other two in such a way as to suggest that it may be a mutation. The plants in question were collected at Amarillo Creek, in Northern Texas, by J. Reverchon, who had recognized them as representing a new species of *Megapterium*.

I am indebted to Dr. Greenman for suggesting a very appropriate name for this species. The diagnosis is as follows:

Megapterium argyrophyllum, sp. nov. Plate 23. figs. 1 and 2.

Herba cæspitosa; foliis lanceolatis, petiolatis obscurē glanduloso-denticulatis, utrinque densē canescento-pubescentibus; caulibus et alabastris (hypanthio et ovario incluso) canescente pubescentibus; ovarium quadrialatum, pedicellatum; hypanthium 9–10 cm. longum, paulatim ad basin coni dilatum; petala 3–4 cm. longa.

Var. **retusifolium,** var. nov. Plate 23. fig. 3.

A forma typica differt foliis subrotundis bis oblongo-obovatis, retusis, mucronatis; floræ grandioræ (petala 45 mm. longa).

Specimens examined:

Texas: on rocky bluffs at Amarillo Creek, in northern Texas, 29 May, 1902, *J. Reverchon, 2749* (Mo. Bot. Gard. Herb.), TYPE; stony bluffs along Red River, Randall Co., northern Texas, 12 August, 1900, *H. Eggert* (Mo. Bot. Gard. Herb., 4 sheets).

Two of the specimens, one slightly older than the other (see pl. 23 fig. 1, 2), represent the type of the species. The plants are cæspitose or with very short internodes, leaves coriaceous, lanceolate, broad-pointed, tapering below to a petiole, about

[1] Issued January 30, 1915.

8 cm. long by 2 cm. in greatest width, margin distantly and obscurely glandular-denticulate, very densely and uniformly covered on both surfaces with an appressed canescent pubescence of long, pointed, tuberculate hairs. Stems and buds less densely covered with the same type of pubescence, ovary four-winged, 10–15 mm. in length, densely canescently pubescent, pedicellate; hypanthium 9–10 cm. in length, 2–2.5 mm. thick, gradually widening to base of cone; bud cone 30–35 mm. in length, diameter at base 8 mm., sepal tips appressed, 3–4 mm. in length, petals 3–5 cm. long, stigma surrounded by or slightly exceeding the stamens; capsules immature.

The remarkable canescent pubescence covering the whole plant, as well as the cæspitose habit, distinguish this species from *Megapterium missouriensis* (Sims) Spach, and *M. macrocarpum*.[1] The flowers are also smaller, there are no purple spots on the sepals, and the hypanthium is shorter than in these species, which differ in foliage as well. The present species is apparently perennial. Its nearest relative is *M. Fremontii* (Watson) Britton, from which it differs in the more cæspitose habit, larger flowers, and much broader leaves.

The variety *retusifolium* is founded on the third specimen on the sheet (see pl. 23 fig. 3). It differs sharply from the species in the shape of the leaves, which are very broad and blunt at the point, subrotund to oblong-obovate, retuse, and distinctly mucronate. The margin of the leaves is also nearly or quite entire. The flowers are larger (petals 45 mm., bud cone 9 mm. in diameter at base). Microscopic examination of the hairs disclosed considerable variation in size, but apparently no constant difference from those of the species.

The Eggert specimens, while obviously belonging to the same species, show much more variability in foliage. The leaves vary on different specimens from narrowly lanceolate (9 mm. in width) to broad oblong-lanceolate (30–36 mm. wide) and acuminate. The latter resemble var. *retusifolium* except the leaf tips, which are only slightly retuse in one specimen. One of the broad-leaved specimens also has a smaller flower (petals 20 mm.). Cultures from seeds from this locality would doubt-

[1] **Megapterium macrocarpum** (Pursh), comb. nov.
Œnothera macrocarpa Pursh, Fl. Am., Sept. 2: 734. 1814.

less disclose a considerable number of forms. The ripe fruits from these specimens are broadly winged, nearly orbicular, about 35 mm. long and 25 mm. wide, retuse or acuminate at the apex.

Examination of herbarium specimens of *M. missouriensis* (Sims) Spach makes it evident that the polymorphism in this species as now understood is quite as great as in many species of *Œnothera*. There are included races varying in amount and character of pubescence, in width of leaf from broadly lanceolate to almost linear, in presence or absence of purple spots on the sepals, in size of flower, and other features.

EXPLANATION OF PLATE

PLATE 23

Figs. 1 and 2. *Megapterium argyrophyllum.* From the type specimens, J. Reverchon, No. 2749 in part, in the Herbarium of the Missouri Botanical Garden.

Fig. 3. *M. argyrophyllum* var. *retusifolium.* From the type specimen, J. Reverchon No. 2749 in part, in the Herbarium of the Missouri Botanical Garden.

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GATES—MEGAPTERIUM

COCKAYNE, BOSTON.

DIAGNOSES OF FLOWERING PLANTS, CHIEFLY FROM THE SOUTHWESTERN UNITED STATES AND MEXICO[1]

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The present paper is the result of a study of several collections of plants from the southwestern United States and Mexico, especially the relatively large series of specimens secured by Mr. Harley P. Chandler at Rio Hondo, Texas, and by Mr. Charles Russell Orcutt along the Texas-Mexican boundary and in various parts of Mexico. These collections have been received at the Missouri Botanical Garden for identification and incidental to the work thereto the following plants seem to the writers to be worthy of record and characterization.

Anthericum (Hesperanthes) Chandleri Greenman & Thompson, sp. nov.

Fibræ radicales carnosæ apice clavatæ, collo radicis parce fibroso; foliis plurimis 12–15 graminoideis planis lanceolato-linearibus sensim attenuatis acutis 3.5–4.5 dm. longis 7–10 mm. latis circiter 24-nerviis cum venis transversis conjunctis utrinque glabris integerrimis; scapo 1 m. alto tereti glabro bracteato, bracteis plus minusve foliiformibus sursum gradatim reductis; inflorescentiis paniculatis usque ad 3.5 dm. longis glabris, racemo terminali 2–2.5 dm. longo, racemis lateralibus 1–1.5 dm. longis, bracteis triangulari-acuminatis vel lanceolato-attenuatis subscariosis 3–20 mm. longis; floribus 2–4 in axillis bractearum; pedicellis 10–12 mm. longis infra medium articulatis; perianthio pallido-flavo vel stramineo, laciniis oblongo-lanceolatis trinerviis circiter 1 cm. longis; staminibus perianthio duplo brevioribus, filamentis muricatis; stylo 8 mm. longo glabro; capsula matura ignota.

[1] Issued January 30, 1915.

Specimen examined:

Texas: vicinity of Rio Hondo, Cameron County, September, 1913, *Harley P. Chandler, 7059* (Mo. Bot. Gard. Herb.), TYPE.

This species belongs to the subgenus *Hesperanthes* according to Baker's treatment of this group (Jour. Linn. Soc. Bot. **15**: 253–363. 1876); it is apparently most nearly related to *A. stenocarpum* Baker, a co-type of which is in the herbarium of the Missouri Botanical Garden, from which it is readily distinguished by the broader leaves, entire leaf-margins, the presence of anastomosing cross-veins, and by the leafy scape and yellow flowers.

Zephyranthes chrysantha Greenman & Thompson, sp. nov.

Bulbus subglobosus 2–2.5 cm. diametro tunicis brunneo-nigrescentibus vestitus, collo 3–5 cm. longo 6–8 mm. diametro; foliis 2–4 sub anthesi evolutis linearibus 2.5–4.5 dm. longis 2–3 mm. latis glabris; scapis 2–3 dm. altis glabris; spatha membranacea 2.5–3.5 cm. longa inferne tubulosa, tubo 1–1.5 cm. longo, lobo unilaterali lanceolato 1.5–2 cm. longo; pedicellis 2.5–3.5 cm. longis gracilibus; perianthio infundibuliformi 3–3.5 cm. longo flavo 6-lobato, tubo cylindraceo circiter 5 mm. longo, lobis oblanceolatis 3–3.2 cm. longis 5–12 mm. latis acutis staminibus ad apices tubi perianthii insertis segmentis perianthii duplo brevioribus; stylo brevitrilobato staminibus subæquantibus; capsula depresso-globosa 10–12 mm. longitudine et diametro, seminibus numerosis irregulariter compressis 5–6 mm. longis 2–5 mm. latis atratis et sæpe nitidis.

Specimen examined:

Texas: Rio Hondo, Cameron County, September, 1913, *Harley P. Chandler, 7056* (Mo. Bot. Gard. Herb.), TYPE.

The species here characterized is allied to *Z. Eggersiana* Urb., particularly in the size and color of the flowers, but differs in having more numerous and broader leaves, shorter perianth-tube and longer spathes.

Sisyrinchium angustissimum (Rob. & Greenm.) Greenman & Thompson, comb. nov. Plate 24.

S. alatum Hook. var.? *angustissimum* Rob. & Greenm. Am. Jour. Sci. **50**: 166. 1895.

Radices carnoso-fibrosi fasciculati; caulibus erectis strictis vel

subflexuosis 2.5–9 dm. altis multo-ramosis angustissime ancipiti-alatis foliosis glabris vel obscure hirtello-puberulentis basi reliquiis brunneis fibrosis squamarum et foliorum primorum obtecto; foliis radicalibus linearibus gramineis usque ad 4.5 dm. longis 1–4 (rarius 6) mm. latis crebrenerviis glabris vel marginibus hirtellis, eis caulinis conformibus sed sursum gradatim reductis; spatha diphylla, bracteis foliiformibus 1.5–2 cm. longis glabris marginibus plus minusve purpurascentibus, pedicellis 2–4 ex eadem spatha 1.5–2.7 cm. longis gracilibus glabris; perianthio profunde 6-partito verisimiliter flavo, lobis ovato-ellipticis acutis vel emarginatis et submucronatis 5–7-nerviis; ovario oblongo-obovato juventate sæpe pubescenti glabrato; capsula matura oblonga 5–10 mm. longa 4–6 mm. diametro glabra, seminibus subglobosis circiter 1.5 mm. diametro in sicco nigrescenti.

Specimens examined:

Mexico: State of Oaxaca, Sierra de San Felipe, altitude 2895 m., 22 June and 29 August, 1894, *C. G. Pringle, 4703* (Mo. Bot. Gard. Herb.), CO-TYPE; Sierra de San Felipe, altitude 3048 m., August–September, 1894, *Charles L. Smith, 758* (Mo. Bot. Gard. Herb.). State of Morelos, lava beds above Cuernavaca, altitude 2590 m., 19 November, 1902, *C. G. Pringle, 11191* (Mo. Bot. Gard. Herb.). State of Puebla, vicinity of San Luis Tultitlanapa, near Oaxaca, June, 1908, *C. A. Purpus, 3356, 3357* (Mo. Bot. Gard. Herb.).

After a careful reëxamination of the original material on which this variety was based, particularly in the light of additional specimens from subsequent collections, it seems undesirable to retain the plant as a variety of *S. alatum* Hook. Mr. Hooker's species was founded on specimens collected in Demerara, British Guiana, by Dr. Hancock; and specimens secured by Mr. Gardner in the Organ Mountains of Brazil and by Tweedie on the marshes of the La Plata River were considered conspecific. While the writers have not seen any of these specimens, yet from the original description and the illustration accompanying it that species is interpreted as having a broadly winged stem, short and relatively broad ensiform leaves, and broad spathes. These characters can not be applied properly

to the Mexican plant in question. It seems advisable, therefore, to regard the south Mexican plant as a distinct species which may be further characterized as above.

OECOPETALUM Greenman & Thompson, gen. nov. *Icacinaceæ*

Calyx 5-lobus. Petala 5 hypogyna valvata intus costata, margine et apice inflexa. Stamina 5 hypogyna petalis alterna et iis basi cohærentia, filamentis dilatis glabris apice contractis; antheræ erectæ lanceolatæ basi sagittatæ connectivo latiusculo; thecæ lateralæ remotæ et in cavitatibus petalorum receptæ. Discus obsoletus. Ovarium uniloculare, stylus erectus conicus, stigma terminale. Ovulum 1 pendulum. Fructus ignotus.—Frutices vel arbores. Folia alterna coriacea integerrima. Flores cymis brevibus axillaribus dispositi.

O. mexicanum Greenman & Thompson, sp. nov. Plate 25.

Frutex (?) vel arbor (?); ramis cortice griseo tectis; ramulis juventate sericeo-pubescentibus mox glabratis; foliis alternis petiolatis elliptico-lanceolatis 1–2.5 dm. longis 3.5–10 cm. latis brevi-acuminatis obtusis integerrimis utrinque glabris vel praesertim in nerviis sparsissime adpresso-puberulentis subtus pallidioribus basi sensim angustatis acutis, petiolis 7–15 mm. longis supra canalyculatis; inflorescentiis in axillariis superioribus cymosis plus minusve adpresso-sordido-pubescentibus, pedunculo usque ad 2 cm. longo; floribus cum pedicello articulatis et caducis; calyce griseo-tomentoso parvo circiter 2 mm. alto 5-lobato, lobis ovatis obtusis 1 mm. longis; petalo 5 oblongo-lanceolato 8 mm. longo 2 mm. lato verisimiliter albo utrinque glabro intus longitudinaliter insigniter unicostato; ovario et stylo glabro; fructu et seminibus ignotis.

Specimen examined:

Mexico: State of Vera Cruz, Sierra Madre near Miscantla, August, 1912, *C. A. Purpus, 6159* (Mo. Bot. Gard. Herb.) TYPE.

Specimens of the plant here described were submitted to the Missouri Botanical Garden for determination by Mr. T. S. Brandegee who suggested its probable relationship with *Mappia*. After a careful study of the material at hand it seems unmistakably to belong to the *Icacinaceae*, but until the fruit is known its exact position in the family must remain doubtful.

In habit and in the structure of the flower it possesses certain characters in common with *Mappia*, *Kummeria* and *Poraqueiba*, but in a combination of the floral characters, particularly in the free or merely coherent glabrous and strongly ribbed petals, the broad smooth filaments, elongated anthers, which in cross section are distinctly x-shaped, and in the single suspended ovule the plant in question differs from the genera above mentioned. Generic rank is therefore given to it and we propose the name **Oecopetalum,** from οἶκος house and πέταλον petal, in reference to the little recesses or pockets formed by the adjacent petals in which the anthers rest.

Stemodia linearifolia (Morong) Greenman & Thompson, comb. nov.

Stemodiacra linearifolia Morong, Ann. N. Y. Acad. Sci. **7**: 183. 1893.

Stemodia tomentosa (Mill.) Greenman & Thompson, comb. nov.

Erinus tomentosus Mill. Dict. 1768. [8th ed.]—*Herpestes tomentosa* Schlecht. & Cham. Linnæa **5**: 106. 1830.—*Stemodia lanata* Ruiz & Pav. in DC. Prodr. **10**: 383. 1846; Hemsl. Biol. Cent.-Am. Bot. **2**: 450. 1882.—*Stemodiacra tomentosa* O. Kuntze, Rev. Gen. **2**: 466. 1891.

Siphonoglossa Greggii Greenman & Thompson, sp. nov.

Suffruticosa; caulibus erectis vel adscendentibus 0.5–2 dm. longis subcylindratis et sæpe quadrisulcatis pubescentibus in lineis decussatis cum pilis reflexis; foliis oppositis brevipetiolatis lanceolatis vel obovatis 0.5–2.5 cm. longis 3–7 mm. latis acutis vel obtusis vel rotundatis integris basi in petiolum gradatim angustatis supra glabris subtus paulo pallidioribus juventate secundum nervos venasque adpresso-puberulentis; floribus in axillis supernis solitariis sessilibusque, bracteis subspathulatis; calyce profunde 5-partito 4 mm. longo, laciniis lineari-lanceolatis glabris; corolla 1.5–2 cm. longa bilabiata, labio anteriore horizontaliter patenti trilobulato, labio posteriore suberecto emarginato, tubo gracili 9–14 mm. longo extus pubescenti; ovario et stylo glabro; capsula circiter 7 mm. longa glabra, seminibus suborbicularibus compressis verrucosis circiter 2 mm. diametro.

Specimens examined:

Mexico: State of Tamaulipas, Matamoras, 7 June, 1847, *Dr. J.*

Gregg, 915 (Mo. Bot. Gard. Herb.), TYPE; Cervallo, 29 May, 1847, *Dr. J. Gregg, 845* (Mo. Bot. Gard. Herb.).

Texas: Rio Hondo, Cameron County, September, 1913, *Harley P. Chandler, 7081* (Mo. Bot. Gard. Herb.).

The species here proposed is nearly related to *S. Pilosella* Torr. from which it is distinguished by the pubescence of the stem, namely reflexed hairs disposed in decussating lines, somewhat narrower leaves, and uniformly shorter fruit.

Siphonoglossa Pilosella Torr. Bot. Mex. Bound. 124. 1859.

This species is well represented in the herbarium of the Missouri Botanical Garden by a suite of more than thirty specimens. To it should be referred one of Lindheimer's Texas plants, namely number 1065, collected in 1851, which by clerical error was distributed as "*Ruellia Parryi* Gray."

Randia Gaumeri Greenman & Thompson, sp. nov.

Frutex ramosus; caule ramisque cortice griseo glabro tectis; spinis axillaribus usque ad 1.5 cm. longis divaricatis; foliis obovatis 0.5–1.5 cm. longis apice plerumque rotundatis integris basi in petiolum marginatum contractis utrinque glabris vel supra in nervis ad basin puberulentis; floribus axillaribus sessilibus; calyce toto 1–1.5 mm. longo 4-lobato glabro; lobis triangularibus acutis ciliatis; corolla hypocraterimorpha parva 4-lobata, tubo cylindraceo circiter 2.5 mm. longo extrinsecus glabro, lobis contortis ovatis tubo subaequantibus; antheris ad faucem corollæ sessilibus exsertis; ovario biloculari; bacca ignota.

Specimen examined:

Mexico: State of Yucatan, at Izamal, coll. of 1895, *Dr. Geo. F. Gaumer, 589* (Mo. Bot. Gard. Herb.), TYPE.

The divaricately spreading axillary spines, relatively small obovate leaves, and the minute flowers amply distinguish this species from all others of the genus. It is with pleasure that the authors dedicate this new species to Dr. Gaumer, who has done so much to further our knowledge of the flora of Yucatan.

Randia Purpusii Greenman & Thompson, sp. nov.

Verisimiliter frutex; ramis ramulisque cortice brunneo vel griseo tectis; spinis ad apices ramorum plerumque quaternis vel binis, vel rarius nullis, 3–6 mm. longis; foliis lanceolatis vel obovato-lanceolatis 1.5–5.5 cm. longis 0.8–2 cm. latis obtusis

vel acutis integris basi in petiolum marginatum gradatim angustatis supra hirsutis subtus paulo pallidioribus et subtomentosis; stipulis triangulari-ovatis utrinque pubescentibus; floribus sessilibus axillaribus terminalibus; calyce toto 6–7 mm. longo 4-lobato, tubo 1.5 mm. longo sericeo, lobis linearibus vel anguste spathulatis 3–3.5 mm. longis patentibus parce pubescentibus; corolla hypocraterimorpha profunde 4-lobata, tubo cylindraceo fere 1.5 cm. longo extus parce piloso, lobis oblongo-lanceolatis tubo subæquantibus; antheris ad faucem corollæ paulum exsertis; ovario biloculari, ovulis plurimis; fructu ignoto.

Specimen examined:

Mexico: State of San Luis Potosi, Minas de San Rafael, May, 1911, *C. A. Purpus, 5208* (Mo. Bot. Gard. Herb.), TYPE.

Randia truncata Greenman & Thompson, sp. nov. Plate 26.

Frutex erectus 3–4 m. altus ramosus; caule ramisque tereti cortice griseo tectis juventate parce strigulosis mox glabratis; spinis 0.5–1 cm. longis binis ad apices ramorum; foliis obovatis vel spathulatis 0.5–3 cm. longis 0.3–1.7 cm. latis ad apicem rotundatis obtusis vel submucronato-acutis integris utrinque glabris basi in petiolum marginatum plus minusve abrupte contractis; floribus sessilibus axillaribus terminalibus; calyce toto 1.5–2 mm. longo, limbo cupuliformi truncato; corolla hypocraterimorpha in sicco atrato, tubo cylindraceo 1–1.5 cm. longo extus glabro intus sparse piloso, lobis subovatis 4–5 mm. longis 3–4 mm. latis apice rotundato vel brevissime acuminato; antheris ad faucem corollae sessilibus semiinclusis; bacca immatura globulosa circiter 0.5 cm. diametro.

Specimens examined:

Mexico: State of Yucatan, vicinity of Izamal, coll. of 1895, *Dr. Geo. F. Gaumer, 713*, TYPE, and *506* (both in Mo. Bot. Gard. Herb.); road to Progresso north of Merida, 7 April, 1865, *Schott, 262* (Mo. Bot. Gard. Herb.), distributed as "*R. aculeata.*"

Co-types of the above species may be looked for in herbaria under *R. xalapensis* under which name Dr. Gaumer's material cited above was distributed. From this species, however, *R. truncata* differs in the more obovate outline and the less conspicuous veins of the leaf, the somewhat longer and more slender corolla-tube, and in the smaller truncate calyx.

Sclerocarpus elongatus (Greenm.) Greenman & Thompson, comb. nov.

S. Schiedeanus var. *elongatus* Greenm. Proc. Am. Acad. **32**:309. 1897.

Herbaceus; caule tereti ramoso erecto vel adscendenti 1–1.5 m. alto striato sparse strigoso plus minusve purpurascenti basi lignescenti; foliis brevipetiolatis trinerviis inferioribus oppositis superioribus alternis anguste lanceolatis 2.5–13 cm. longis 0.3–1.5 cm. latis acuminatis acutis integris vel remote denticulatis basi in petiolum gradatim angustatis supra tuberculato-hispidis subtus paulo pallidioribus secundum nervos venasque hirsutis; inflorescentiis laxe paniculatis, pedunculis gracilibus 0.5–8 cm. longis strigosis; capitulis 6–8 mm. altis; involucris subcampanulatis circiter 5 mm. altis, squamis biseriatis oblongo-lanceolatis ovatis vel subobovatis extus strigoso-pubescentibus ciliatis leviter atratolineatis; flosculis liguliferis 5–8, ligulis oblongis 6–10 mm. longis flavis; floribus disci circiter 30; achæniis maturitate obliquis striatis glabris.

Specimens examined:

Mexico: State of Morelos, fields around Cuernavaca, altitude 1585 m., 31 October, 1896, *C. G. Pringle, 6606* (Mo. Bot. Gard. Herb.), CO-TYPE; valley, near Cuantla, altitude 1370 m., 28 October, 1900, *C. G. Pringle, 9061* (Mo. Bot. Gard. Herb.). State of Vera Cruz, Ojapa, 30 June, 1910, *C. R. Orcutt, 5156* (Mo. Bot. Gard. Herb.).

Venezuela: without definite locality, *A. Fendler, 685* (Mo. Bot. Gard. Herb.).

A further study of co-type material of this species, supplemented by subsequent collections, and a careful comparison of it with *S. Schiedeanus* (DC.) Benth. & Hook. f., as represented by Schiede's number 225 preserved in the herbarium of the Missouri Botanical Garden and Pringle's number 8338 from the type locality, shows several important differences between the species and the plant referred to it as variety *elongatus*. The latter has narrowly lanceolate leaves, a much-branched stem, open inflorescence, and more numerous and smaller heads which altogether indicate that the plant in question should be regarded as of equal specific rank rather than a variety of *S. Schiedeanus*, hence it is here raised to specific rank and a somewhat amplified description is appended.

Flaveria longifolia Gray, Pl. Fendl. 88. 1849.

Var. **subtomentosa** Greenman & Thompson, var. nov.

Formæ typicæ habitu simili; caule plus minusve tomentoso; foliis lanceolato-attenuatis basi plerumque ampliatis amplexicaulibusque utrinque subtomentosis.

Specimens examined:

Mexico: State of San Luis Potosi, Minas de San Rafael, November, 1910, *C. A. Purpus, 4776* (Mo. Bot. Gard. Herb.), TYPE; Rio Verde, 17 November, 1910, *C. R. Orcutt, 5421* (Mo. Bot. Gard. Herb.); Rio Verde, 2–8 June, 1904, *Dr. Edward Palmer, 26* (Mo. Bot. Gard. Herb.).

Explanation of Plate

PLATE 24

Sisyrinchium angustissimum (Rob. & Greenm.) Greenm. & Thomp.

Mexico

From the type number, Pringle No. 4703, in the Herbarium of the Missouri Botanical Garden.

GREENMAN AND THOMPSON—DIAGNOSES OF FLOWERING PLANTS

COCKAYNE, BOSTON.

Explanation of Plate

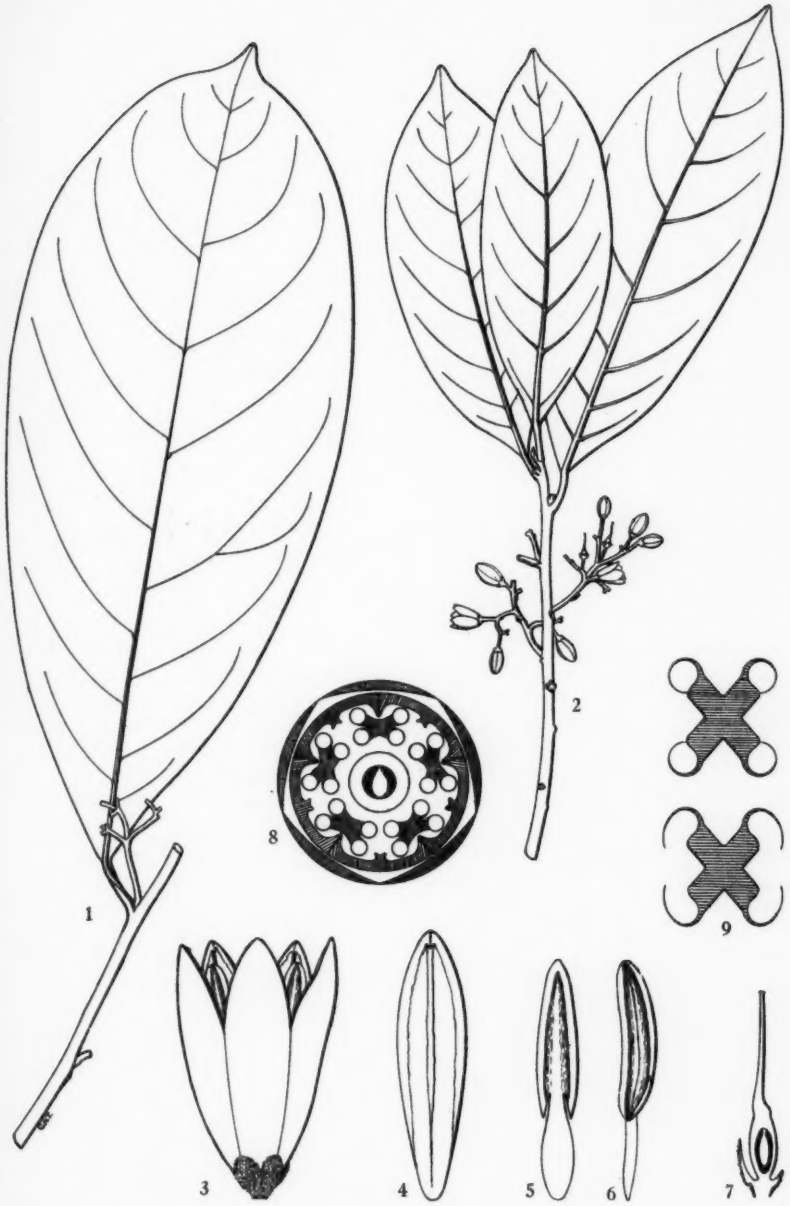
PLATE 25

Oecopetalum mexicanum Greenm. & Thomp.

Figs. 1 and 2, flowering branches; 3, flower; 4, inner face of petal; 5 and 6, front and side view of stamen; 7, longitudinal section of pistil; 8, diagrammatic cross-section of flower bud; 9, diagrammatic cross-section of anther before and after dehiscence.

Mexico

From the type specimen, Purpus No. 6159, in the Herbarium of the Missouri Botanical Garden.



GREENMAN AND THOMPSON—DIAGNOSES OF FLOWERING PLANTS

COCKAYNE, BOSTON.

Explanation of Plate

PLATE 26

Randia truncata Greenm. & Thomp.

Mexico

From the type specimen, Gaumer No. 713, in the Herbarium of the Missouri Botanical Garden.

GREENMAN AND THOMPSON—DIAGNOSES OF FLOWERING PLANTS

COCKAYNE, BOSTON.

ENZYME ACTION IN FUCUS VESICULOSUS L.

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Little is known regarding the metabolism of the *Fucaceæ*. The chemical nature of the chief accumulation products has not yet been sufficiently investigated. In fact, prior to 1905 very little work of importance had been contributed on the products of any group of the marine algæ. Even the chemical determination of the carbohydrates, for example, in some of the larger groups of algæ, afforded no suggestion as to the nature of these products. More activity in this general field of work has been manifest, however, since the date referred to. Diverse views prevailed regarding the nature of the various granules which had been long detected microscopically. In the earlier literature Hansteen's ('92, '00) opinion has generally dominated, by which it was claimed that the granular bodies of the cell—and particularly the larger vesicular forms—contain fucosan, a carbohydrate, which was considered the first visible product of photosynthesis. On the other hand, Crato ('92, '93) maintained, from microchemical reactions, that the larger vesicles, physodes as he called them, contained phloroglucin, or some derivative of this body. Müther and Tollens ('04) found a methylpentosan in *Fucus* and *Laminaria*, while Koenig and Bettels ('05) among others found glucose and fructose, as well as pentoses and methyl pentoses, in *Laminaria* after hydrolysis. Swartz ('11) gives an extensive summary of the previous work on carbohydrate occurrence in the algæ, and contributes much data on the digestion of the hemicelluloses, but she studied no brown algæ. The existence of reducing sugars in *Fucaceæ* was clearly shown by Tihomirow ('10). Recently the carbohydrates have been more completely investigated by Kylin ('12, '13). Nevertheless, much remains to be done on these products, while

the proteins (aside from agar agar and related compounds) and other organic substances are scarcely known.

In view of the very considerable data on the carbohydrate metabolism in higher plants, it seems particularly desirable to investigate further this relation in the brown algæ. Moreover, no general study having been made, as far as we could learn, of the enzymes of the *Fucaceæ*, it seemed possible that a determination of the more characteristic enzymes, and of their distribution in *Fucus*, might lead to a better comprehension of the nature of the metabolism of these plants. Accordingly, during the summers of 1913–14 we have made an examination of *Fucus vesiculosus* with respect to its enzyme content.

In preparing the Fucus material for study we have followed several of the customary methods which have been found satisfactory in yielding enzymes of a high degree of efficiency. Since our results with *Fucus* have been so generally negative with respect to the presence of the commoner enzymes of plant metabolism, it may be well to indicate briefly how the material was handled. The Fucus plants were obtained in quantity, apparently in a condition of active growth, and the material was carefully picked over to avoid the contamination of attached animals and smaller algæ, then washed, and finally treated by one of several methods. Some of it was hung in a shaded, warm room until quite dry and brittle, then ground in a mill to an extremely fine powder, the latter being preserved in dry bottles for extraction, as subsequently indicated. For other phases of the work the plants fresh from the water were ground almost to a pulp in a meat grinder, sometimes passing the material twice or oftener through the machine. In some cases this fresh pulp, further comminuted in a mortar, or an extract from it, was used directly, while in other cases an alcohol-acetone dry preparation was made from it—the latter by treating alternately with 95 per cent alcohol (15 minutes) and acetone (5–10 minutes) until practically dehydrated, with a final brief treatment with absolute alcohol or ether, when the material was spread out on filter paper to dry. The alcohol-acetone material was thoroughly pulverized in a mortar for further use.

In the preparation of extracts the dry material was treated with distilled water (usually 10 parts of water to 1 part of

material), or in some cases with sea-water, using commonly 20 per cent alcohol or 2–3 per cent toluene as a preservative. In general, toluene has proved the most satisfactory antiseptic. The filtered extract was then precipitated with 95 per cent alcohol, the precipitate caught on a filter, washed with alcohol and dried. In a few cases the extract was used direct, and in certain respects the common practices were variously modified in the hope of detecting some simple explanation of the large number of negative results.

The hydrolytic experiments were carried out in small Erlenmeyer flasks or test-tubes, and always in duplicate or triplicate. In addition, nearly every series was repeated once or oftener. A special effort was made to determine the presence of carbohydrases, and for this purpose weak solutions, usually 0.5 per cent, of starch, glycogen, dextrin, saccharose, maltose, and lactose were employed in numerous tests. No reduction, or no change in the reducing value of the substrate, by the Fehling method, was found in any case in our final experiments, although in some cases a relatively large quantity of the supposedly enzyme-containing material was used. We found it necessary to purify the best dextrin obtainable by precipitation with 95 per cent alcohol from a strong aqueous solution. In the preliminary experiments, and chiefly with one preparation, traces of reduction were found with glycogen, but in many later experiments this finding was not confirmed.

Owing to the consistently negative results with these carbohydrates it seemed possible that there might be an adjustment of enzyme action in *Fucus* such that a relation of the mineral salts, as in sea water, might be requisite for highest action. Consequently the enzyme solution in one large series of experiments was diluted with double strength sea-water; in another case the material was extracted with sea-water; and finally, fresh material was used, making with it a diffusion in sea water. In every instance the result was negative.

Another possibility then suggested itself, namely, that the presence of certain inhibiting substances might account for the absence of hydrolytic change. Accordingly, the effect of the Fucus material on the activity of taka diastase was determined in this way: To 10 grams of ground fresh material 100 cc. of

water and 1 gram of taka diastase were added, this being permitted to stand for 5 hours, as in extraction, and the filtrate from this extraction was tested upon starch solution. The results were positive, indicating that no free substances were present which could inhibit diastase action. In another test 1000 grams of Fucus material were divided into two lots of 500 grams each. To one of these, 5 grams of commercial malt diastase were added, and both were then treated by the alcohol-acetone method, and subsequently extracted and precipitated in the usual way. The material to which diastase had been added gave positive tests for the hydrolysis of carbohydrates in an extensive series with dextrin, glycogen, saccharose, and laminarin; but a solution of the precipitate from the lot receiving no diastase produced no changes in these substrates. These experiments included controls of several kinds. With every substrate, boiled material was also used, and it is interesting to note that the "enzyme" material increased in reducing power with boiling.

The tests referred to in the previous paragraph seemed all the more important inasmuch as the Fucus material had been found to be strongly acid, and it seemed possible that this acidity alone might prove an injurious factor. From the experiments just mentioned it is seen, however, that acidity could scarcely have been an important consideration. A quantitative determination of the acidity was nevertheless made, by titration with NaOH, and it was found to be about .0565 N HCl. There is a slight increase in the acidity, if the pulp is permitted to remain in water 12 hours.

Owing to the determination by many, as, for example, Müther and Tollens ('04), Kylin ('13), Swartz ('11), and others of the presence of hemicelluloses, especially pentosans, in the marine algæ, and, further, since the commoner carbohydrate enzymes had not been identified by us, it seemed desirable to examine the material for pentosanase. The most available pentosan was that of cherry gum, accordingly this material in fresh condition was obtained and utilized in many tests with the Fucus preparation, the flasks being maintained at temperatures ranging from 27–40° C. Although the experiments were permitted to run for a period of several days, no reduction above the amount found

in the controls was obtained, and certainly no pentosanase active on this material could be assumed to occur abundantly in Fucus tissues.

Only one series of tests has been made to identify cellulase in the material here reported upon, and the results are presented with much reserve. Precipitated cellulose, prepared from filter paper, was employed, and the experiments were conducted at 40° C. The indications were that slight cellulase activity may occur.

By means of the action of the alcohol-acetone preparation upon a 4 per cent olive oil-casein emulsion, the lipolytic activity was investigated in the usual way. With the emulsion used alcohol is most serviceable as a preservative. In the tests referred to there was no indication of hydrolysis after one week; so the preparations were permitted to stand for two months, but still without change. That the conditions in the above case were otherwise favorable for lipolytic action is shown by the fact that the same substrate yielded with an alga of another family a decidedly positive test in two days. Several series of experiments were likewise carried out for the determination of esterases. With methyl acetate, ethyl acetate, and ethyl butyrate the Fucus material produced no change, irrespective of the concentrations employed.

In some of our preliminary experiments it had appeared that urease was present, but a careful investigation of this point demonstrated an error in the earlier results, and no amidases were discovered through the action upon 0.5 per cent solutions of urea, acetamid, methylamine, asparagin, diphenylamine, and acetanilid. In these experiments NH_3 determinations were made according to the method of Folin.

No liquefaction of gelatin or of agar occurred during a ten-day interval in a large series of test-tubes arranged with these two substrates. In the different tests these media were made neutral, alkaline, and slightly acid. In the neutral and slightly acid tubes no observable change occurred; but in those tubes containing a higher percentage of acid — both in those containing the Fucus preparation and in the controls — general liquefaction occurred. It is obvious, therefore, that these gel-forming proteins are not noticeably affected by any enzymes

occurring in the Fucus material. More extensive series of tests were arranged to determine the presence of proteinases which might act upon some more widely distributed native proteins, such as albumin, casein, and legumin. No tests were made to determine the transformation of these bodies into proteoses or peptones, but the formaldehyde method of determining amino acids was employed, and in no case had any transformation of these substances proceeded to the amino acid stage.

Glucose, levulose, and galactose were used in two series of experiments designed to determine the presence of zymase in the alcohol-acetone Fucus powder. No sufficient evidence, however, of the occurrence of this enzyme was obtained even when the most delicate tests were employed to determine the liberation of CO_2. The action of Fucus extract from the alcohol-acetone preparation upon tannin was tested by means of quadruplicate experiments. Two concentrations of tannin were used, 1 per cent and 2.5 per cent. The determinations were made by means of Jean's iodine method, but in no case did the flasks receiving the Fucus extract exhibit hydrolysis greater than that shown by the controls. Neither prepared nor fresh Fucus material gave sufficient evidence of oxidase or peroxidase action to be considered positive. Negative results were obtained both by the direct method with gum guaiacum, and by the indirect method, in which the reagent mentioned is used with hydrogen peroxide, and apparently acidity is not a determining factor. The use of benzidine seemed to indicate oxidase activity, but it has been clearly shown that the ease with which this reagent undergoes "spontaneous" oxidation in boiled solutions necessitates caution in using it as a test of oxidase activity. Tests for catalase by the usual method, evolution of oxygen on the addition of hydrogen peroxide, have clearly indicated that this enzyme is widespread in *Fucus*. It should be noted that the findings with respect to oxidase and catalase activity are in agreement with those of Atkins ('14). Catalase was very generally identified by him in the algæ, but evidence of oxidase in the *Fucaceæ* was obtained only with benzidine as a reagent.

The unexpectedly negative character of the experimental work here briefly outlined prompted us to make many repeti-

tions of experiments and minor modifications in technique not referred to in this preliminary account. The nature of the results, furthermore, made it seem desirable that a much more general study be made of the abundance and distribution of the enzymes in the various families of the marine algæ, and such an investigation is now in progress by one of us.

It would seem idle to attempt here an explanation of the negative results obtained, yet two or three possibilities have occurred to us which may be mentioned. The conditions of life of the *Fucaceæ*, especially the temperature relation, make it possible to suspect that metabolic changes occur at a very slow rate. If this is the case, it might be assumed that the commoner metabolic enzymes might be present in such small quantity that an indication of their presence would not be apparent by utilizing the methods ordinarily employed. The very fact that the capacity for food accumulation, that is to say, the "storage" of food materials, has not become highly developed in these forms suggests that the usual enzymes might not be found in abundance. Nevertheless, if such is the case, it may be pointed out that the present methods of enzyme work are very inadequate when applied to metabolic processes in general dealing with the transformation of products which do not accumulate in some quantity in the cell. In this connection attention may be drawn to Arber's ('01) observation on the slow rate of transformation of starch in the thallus of *Ulva latissima*, where a darkening period of from three to five weeks was required for the disappearance of this product.

The other possibility which has suggested itself is that in the cells of the *Fucaceæ* there may occur inhibiting substances which upon the death of the cell may form with the enzymes compounds from which the ferments cannot be again recovered. We have no evidence of the existence of any such bodies. Further investigation of *Fucus* and related algæ should perhaps throw some light upon the negative evidence produced by our extensive data.

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GENERAL INDEX

New scientific names of plants and the final members of new combinations are printed in **bold face** type; synonyms and page numbers having reference to figures or plates, in *italic;* and previously published scientific names and all other matter, in ordinary type.

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